THE ENGINEERING AND MINING JOURNAL.

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NOTE.—Communications relative to the editorial management should be addressed to Mr. ROTHWELL. The articles written by Mr. Raymond will be signed with a star.

CONTENTS.

EDITORIALS:
The Stewart Reduction Works, Georgetown, Col. ... 29
Ross Browne ... 29
New Publications ... 29
The Mineral Resources of Great Britain in 1874 ... 32
Iron and Steel by the Knowles Process ... 30
On the Use of Pulverized Fuel ... 31
Coal and Metal Trades of Boston ... 33
Illuminating Gas ... 34
Explosions in Coal Mines ... 36
Strains in Truss Bridges ... 37
Coal Gas as a Fuel ... 37

CORRESPONDENCE:
The Burns and Harvey Gas Wells, Near Pittsburgh, Pa. ... 37
Selected List of Patents ... 38
Notes ... 38
STATISTICS OF COAL PRODUCTION ... 38
COAL TRADE REVIEW ... 38
Robert Crooks and Co.'s Metal Report ... 40
Iron Market Review ... 41
FINANCIAL:
New York Stocks ... 42
Philadelphia Stocks ... 42
Copper Stocks ... 43
Gold and Silver Stocks ... 43
Gas Stocks ... 43

OWING to the very serious illness of our Secretary and proof-reader, we have to apologize to our readers for some typographical errors in the last few numbers of the JOURNAL, and also for the delay in the publication of the Index of Vol. XX; it will appear next week.

The Stewart Reduction Works, Georgetown, Col.

WE are much gratified to learn from the report of a meeting of Georgetown citizens, published in the *Georgetown Miner*, that the sympathy of the community in that town is to be a substantial one, if necessary, and that Mr. STEWART'S efforts to re-build his works will be heartily seconded by all classes.

Ross Browne.

THE death of Hon. J. ROSS BROWNE, which was reported from San Francisco some weeks ago, deserves mention, even from a technical journal, to which, in general, the lives, deeds or deaths of men outside of its special industry or profession are matters of no moment. Mr. BROWNE was not a mining engineer or metallurgist; but it fell to his lot to communicate to the mining interests of the Pacific Slope a great and timely impulse. His two reports as Commissioner of Mining Statistics, sent to the Secretary of the Treasury in 1867 and 1868, contained a vast amount of interesting and fresh information concerning the resources of the West and the history of its development. The subject was then comparatively a virgin field; and Mr BROWNE reaped its first abundant harvest—gathering doubtless (as who does not?) some useless straw with the grain, but obtaining, on the whole, a remarkably full and valuable return for his labor. In statistical and technical accuracy, his reports are sometimes deficient. When the statements of sanguine citizens needed to be weighed and reduced, or estimates needed to be made, in the absence of trustworthy data, from grounds of practical experience, he did what natural shrewdness, without personal knowledge, could do. It is easy now to criticise his work; but it would not have been easy to do better work at that time. As an artist, traveler and author, he possessed powers of quick observation and the gift of seizing upon salient points of scenery, character, and society, which enabled him to produce, with pen and pencil, striking pictures of the new regions and industries he described. It might be said that, for many purposes, a superficial account from him was of more value than the laborious enumerations of slower minds. A work like his was the necessary and appropriate precursor of the more specialized treatises which later reports of the same series have contained.

Concerning Mr. BROWNE'S literary and political careers, this is not the place to speak at length. As a popular author, he achieved a high degree of success; as a politician, he can scarcely be judged, since he never made that pursuit a serious object of ambition. The Commissionership of Mining Statistics—an office quite outside of party politics—he probably accepted because it suited the ruling passion of his life, which was the restless longing to travel; and we remember hearing him say that the principal attraction of the position of Minister to China was the opportunity it offered to him for visiting and observing a part of the world which he had not yet seen. At the same time, he was keenly alive to the honor and dignity of that station; and when, in consequence of differences as to diplomatic policy, he was recalled, he took no further active part in politics. The last years of his life were passed chiefly at his residence near Oakland, California, where the reminiscences of many lands seemed to have been incarnated in the quaint outlines, architectural surprises, and devices of comfort and convenience with which he surrounded himself and his family, or hospitably entertained his friends. *

NEW PUBLICATIONS.

ANNUAL REPORT OF THE DIRECTOR OF THE MINT *to the Secretary of the Treasury for the Fiscal Year ended June 30, 1875.* Washington, Government Printing Office.

The wisdom of the policy which created a Mint Bureau in the Treasury Department, and placed at its head Dr. H. R. LINDERMAN, the present Director of the Mint, is proved by the valuable reports which that officer annually prepares, and of which the document before us is an admirable sample. Dr. LINDERMAN'S intelligent, comprehensive, and pertinent statistics will prove more important than mere arguments, in the discussion about specie payments, towards which we are drifting, and in the preliminary skirmishes of which we are already engaged. Hitherto, the principal questions considered have related chiefly to one-half the problem. All that the advocates of hard money have been able to do, has been to prevent the increase of soft money, and to keep before the people the true end towards which financial legislation should steer. The actual measures by which that end shall be secured are still undetermined; and we are safe in saying that the work of choosing them and firmly adhering to them until they shall have achieved their results, will prove more embarrassing than anything that has yet been encountered. It will be necessary, not merely that Congress shall decide upon a policy to be pursued, but that the people shall be so far enlightened as to give that policy support, and to disregard the sophistries of demagogues and sciolists, who will certainly attempt to defeat it. The very first requisite for this work is *facts*. The authoritative announcement of these will strangle at birth, or promptly slay in infancy, a vast amount of nonsense. The able and thorough reports of the Comptroller of the Currency furnish the information required concerning our paper circulation, its distribution, and the operation of our banking system; and the Director of the Mint supplements this by his statement concerning our domestic production, coinage, consumption, import, and export of the precious metals. This statement is made, in the main, in such a way as to be easily understood, and is further reinforced by a mass of interesting information concerning the coinage systems of other countries, and the bullion-product of our own.

The Director reports the deposits (deducting re-deposits) at the mints and assay offices during the year ended June 30, 1875, as follows: gold, $38,556,293.90; silver, $16,070,626.54; total, $54,626,920.44. The product of the mints was:

COINAGE:	
Gold	$33,553,965
Silver	10,070,368
Minor	230 375
Total	$43,854,708
BARS:	
Fine and unparted gold	$16,019,879 93
Fine and unparted silver and sterling	7,029,430 54
Total	$23,049,310 47

The silver deposits include the purchase of about $4,600,000 of fine silver, for coinage to replace the postal currency. These purchases have been continued since the close of the fiscal year, and amounted, at the end of October, to something over $9,000,000, obtained at the average price of $1.11 4-10 per ounce of standard silver. The coining rate of the fractional silver coins being a trifle over $1.24 4-10, the gain on this coinage is about 13 cents per ounce. We recommend to those newspaper critics who have made merry over the proposed substitution of silver for the postal currency, the perusal of Dr. LINDERMAN'S practical remarks on that subject. He shows that the fractional notes last, on the average, about fifteen months, so that the government, to keep in circulation $40,000,000 to $50,000,000 of this currency, has to print $36,000,000 annually, at a cost, for manufacturing, handling, exchanging, etc., of about $1,800,000. This annual expenditure would pay the interest on the investment necessary to issue $45,000,000 of silver coinage, the seigniorage or coinage-profit of which, on the subsidiary coins, would be more than sufficient to pay for its manufacture, distribution and maintenance. The nuisance of counterfeit, torn, dirty, and defaced shinplasters would thus be abated; and all these advantages, together with the incidental gain of a natural market for a portion of our great silver product, are entirely independent of the political squabbles about specie-resumption.

With Dr. LINDERMAN'S views concerning the trade-dollar, we are not so fully in accord. This coin is specially intended for export, and is in reality a bar of silver, of a fineness, weight, and form, intended to suit the Chinese market. The exact necessity for it, and the exact benefit which has been derived from it are not very clearly stated. It appears, however, that its coinage does not affect the general market-price of silver; and that it causes a certain class of bullion to be refined and minted in the United States, instead of being shipped to London, as formerly. In other words, we ship a certain amount of bullion, refined and minted, to China, instead of sending it, unparted, to London. As the charge for coining gold has been repealed, the advantage of this change appears to lie wholly in the facilities which it may confer upon our commerce with the East. On this head, Dr. LINDERMAN merely says that the American trade-dollar has been "well received in that empire, and if authority were given to coin at our Western mints, five, ten, twenty, and fifty-cent pieces of the *same standard*, they would no doubt find a ready market at the different commercial ports, and gradually work their way into the interior of the empire. If this trade-coinage should incidentally afford protection to our mining interests, which have already been injuriously affected by the fall in the value of silver, it could hardly be regarded otherwise than as sound national policy." We do not feel ourselves competent to judge this particular case, which Dr. LINDERMAN has doubtless well considered; but we are quite clear that, as a general question, the policy of coining money for other nations than our own is wrong.

The Director estimates the amount of coin in the country on the 30th June, 1875, at about $142,000,000. The reports which he gives of the operations of the mints are elaborate and instructive. Even the tables of the result of the annual assay, which are, perhaps, more elaborate than instructive—the weight and fineness of numerous single coins and groups of coins in each class and from each mint being interminably tabulated—are, nevertheless, interesting, as showing exactly the system pursued in obtaining the final averages by which the work of the mints is to be judged.

The imports, exports, and re-exports of gold and silver during the fiscal year are given as follows:

	Imports.	Exports.	Re-exports.
Gold Bullion	$ 1,581,638	$ 2,233,775	$ 3,696
Silver "	1,295,754	17,197,914	11,385
Gold Coin	12,115,155	59,309,770	5,433,736
Silver "	5.908,170	5,115,670	2 825,746
Total 1874—5	$20,900,717	$83,857,129	$ 8,275,013
Total 1873—4	28,454,906	59,699,686	6,930,719
Total 1872—3	21,240,437	73,905,546	10,703,028

From correspondence with the governors and other authorities in various States and Territories, the Director forms the following estimate of the domestic production of the precious metals for the year ending June 30, 1875. (We need hardly say that the period is an inconvenient one, ending, as it does, in the middle of the hydraulic mining season):

Arizona	$ 1,000,000	Oregon	$ 1,665,000
California	17,000,000	Utah	6,844,570
Colorado	5,472,000	Wyoming Territory	250,000
Idaho	2,500,000	Washington Territory	300,000
Montana	4,119,852		
Nevada	31,795,193	Total	$71,946,615
New Mexico	1,000,000		

Of this amount Dr. LINDERMAN estimates that about $40,000,000 was gold. The Comstock bullion now consists, on the average, of 21 parts silver by weight to one part gold, or, say, 60 per cent. in value of silver and 40 per cent. of gold. This circumstance, as the Director pertinently remarks, is overlooked by many who calculate the effect of the Great Bonanza mines in the further depreciation of silver.

We have only space to notice one other feature of the report, namely, the article by Prof. R. E. ROGERS on the Consolidated Virginia and California mines, which is accompanied with maps of surveys, furnished by the companies. The maps are very interesting and valuable. The report of Prof. ROGERS is, of course, intelligent, but it is not satisfactory. This gentleman is a chemist, who was specially engaged to superintend the equipment of the refinery in the new mint at San Francisco, and who discharged that duty with evident thoroughness and skill. His incidental examination of the Comstock mines consumed too little time, and his report upon them occupies too little space, to do the subject or the author justice. The object of the examination is stated to have been the formation of an estimate as to the probable product of the ore-body now exposed in the Virginia and California. Prof. ROGERS walked through the mines, with an assistant carrying a bag, collected specimens, made assays, and applying the data thus obtained to the areas shown by the surveys, found the ultimate yield of the ore-body to be $300,000,000. Then, "to guard against a chance of over-estimating," he cut this down 50 per cent., and "threw in" the whole of the ore contained between the 1400 and 1300-foot levels, as well as the "very promising developments" below the 1550-foot level. He does not furnish any clew to the method which he pursued in sampling, or in estimating ore-reserves, or in applying the results of his assays to the estimated quantities of ore; nor does he say whether he has made allowance for the percentage of metal lost in milling or smelting. Hence, as it stands, his report consists of about a page and a half of general description (very tersely and clearly put, but not new) and two short paragraphs, containing the guess above-mentioned as to the value of the ore in sight. If this were the opinion of an experienced mining engineer, it would carry weight on that account, even though it might seem loose and vague. But as Prof. ROGERS cannot claim that character, his assay and map calculations, divided by two and reinforced with large unknown "amounts" and "developments" thrown in, are simply the experiments of an honest amateur.

The proof-reading of Dr. LINDERMAN'S report is not up to the best standard of the Government office. It must be annoying to the Director to find the simple and familiar title of the Austrian Minister of Finance, FREIHERR VON BUCK, given on page 48 as FREIHUR, and on page 51 as FREIHEN—both times, by way of emphasis, in small caps. The ingenious translator who invented on page 52 the new word *Rechslaw*, ought to have been allowed to use it on page 50, where the word *Reichsgesetz*, employed by common folks, occurs—or else, better yet, forbidden to use it at all. *

The Mineral Resources of Great Britain in 1874.

THE Mineral Statistics for 1874, prepared by Mr. ROBERT HUNT, F.R.S., of the Royal School of Mines, are far less discouraging than might have been anticipated, considering the depression of business which prevailed during the year reported upon. The total decrease in the value of the minerals raised has been less than £2,000,000, and nearly the whole of this is represented in the one item of coal. We subjoin the general summary for the last two years, in order that the movement of the several products may be compared:—

Minerals.	Raised in 1873. Tons.	Value—£.	Raised in 1874. Tons.	Value—£.
Coal	127,016,747	47,631 280	125,043,257	45,849,194
Iron ore	15,577.499	7,573,676	14,844,936½	7,318 169
Copper ore	80,188½	342,708	78,521	336,414
Tin ore	14,885	1,056,835	14,039¼	788,310
Lead ore	73.500½	1,131,907	76,201½	1,024,107
Zinc ore	15,969	61,166	16 829¾	48.195
Iron pyrites	58,924	35,485	56,208	38,226
Arsenic	5.448¾	22,854	6,258½	27,438
Cobalt	6 cwt.	12	....	....
Manganese	8,671¼	57,766	5,778	29,201
Ochre, umber, etc	6,368½	5,410	7,122	9,478
Wolfram	50	526	32¾	545
Bismuth	1¼	68	....	38
Silver ore	....	....	2½	20
Fluor spar	....	....	634½	317
Clays—fine and fire, and shale (estimated)	1,785.000	656,300	2,436,912	780,159
Salt	1,785,000	892,500	2,306,567	1,153,233
Barytes	10,269½	7,993	14,374	12,301
Coprolites & phosphorite	....	....	149,654	388,290
Gypsum	....	.	66,124	33,062
Other earthy minerals est.	....	3 000	....	3,000
Total value of minerals produced		£59,479,486		£57,839,697

METALS OBTAINED FROM THE ORES ENUMERATED.

Minerals.	1873—Tons.	Value—£.	1874—Tons.	Value—£
Iron, pig	6,566,451	18,057,739	5,991,408	16,476,372
Copper	5,240	502,822	4,981	447,891
Tin	9,972	1,379,766	9,942	1,077,712
Lead	54.235	1,263,375	58,777	1,298,463
Zinc	4,471	120,099	4,470	106,773
Gold Ozs.	....	....	385	1,540
Silver	537,707	131,077	509,277	127,319
Other metals (estimated)	....	5.000	....	3,000
Total value of metals		£21,409.878		£19,539,070

Absolute total value of the Metals and Coal, with other Minerals, which are not smelted (except building stones, lime, slates, and common clays), produced in the United Kingdom:—

	1873.	1874.
Value of the metals produced	£21,409,878	£19,589,070
Value of the coal	47,629,787	45,849,194
Value of other minerals	1,681,834	2,446,049
Total value	£70,722,992	£67,834,313

COAL USED IN SMELTING ORES, REFINING, DESILVERIZING, AND MANUFACTURE OF METALS IN THE UNITED KINGDOM.

	1873. Ore smelted and Metal obtained.	1873. Coal used.	1874. Ore smelted and Metal obtained.	1874. Coal used.	1874. Increase.	1874. Decrease.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
TIN.						
Ore, British	14,885		14,039			
Metal "	9,972	42,422	9,942	44,950	2,528	..
Ore, Foreign	5,612		4,305			
Metal "	7,791		9,218			
COPPER.						
Ore, British	80,188		78,521			
Metal "	5,240	360,195	4,981	461,650	101,455	..
Ore, Foreign	427,315		490 860			
Metal "	20,956		27,894			
LEAD.						
Ore, British	73,400		76,151			
Metal "	56,035	169,540	58,754	173,180	3,640	..
Ore, Foreign	11,668		15,060			
Metal "	62,563		62,393			
ZINC.						
Ore, British	15,969		16 973			
Metal "	4,470	190,363	4,501	157,817	..	32,546
Ore, Foreign	20,031		21,335			
Metal "	30,087		22,193			
IRON.						
Ore, British	15,577,499		14,854,894			
Metal "	6,566,451	16,718,532	5,991,408	15,292,201	..	1,426,331
Ore, Foreign	1,242,536		1,009,141			
Bar Iron or Merchant Iron	5,409,203	18,320 830	5,223 476	18,270,150	.	50,680
Total actual decrease in the quantity of coal used in the smelting of metals in 1874 was						1,401,934

Iron and Steel by the Knowles Process.

SIR FRANCIS KNOWLES has sent a letter to the editor of the *Journal of the Society of Arts*, in which he says: "It will be interesting to your readers to learn that the re-agents used in my process of refining and converting cast-iron (caustic soda and oxide of iron) have been recently again tried in the common puddling furnace with complete success. I subjoin the particulars of the trials and their results. As the heat generated by the complete combustion of pyrogen gas is a matter of certainty, the only point remaining to be settled is that of economy and cost, which I believe will not long remain in doubt."

The report is signed R. H. U. A., and says, "The pig-iron was carefully picked out of an uniform quality and borings taken from several pigs. Three heats of this iron were worked in No. 3 furnace (new forge), and three heats in No. 4 furnace. Both furnaces were in exactly the same condition. No. 3 worked in the ordinary way, and No. 4 had the soda worked in after the first rabble. A trial bar was taken from each heat of each furnace, and borings taken from them for analysis. The pig-iron contained—silicon, 2.49; sulphur, a trace; phosphorus, 1.30. The puddled bar from No. 3 furnace (no soda) contained silicon, 10.72; sulphur, a trace; phosphorus, 0.350. The puddled bar from No. 4 (soda) contained silicon, 0.226; sulphur, a trace; phosphorus, 0.044. So that the metal, chemically treated, gave iron quite free enough of phosphorus to work in the Siemens-Martin process.

In an appended note Sir FRANCIS says, "A pyrogen-heated furnace of proper construction may be applied readily to the production of steel directly from the ore, with a scoria so pure as to be suitable to glass-making."

In a further communication to ourselves respecting, the "Production of Steel from the Ore," Sir FRANCIS says, "Since writing the article (published in IRON, vol. ii., p. 677,) it occurs to me that your readers may wish to know in what manner I propose to practically effect the fusion of such steel in large quantities so as to evade the cost of melting once or oftener in pots. I shall suppose for this purpose that we have obtained our metallic sponge from ore originally free from phosphorus, and calcined, if need be, to expel sulphur. The reduction to this state may be effected by charcoal, but I much prefer, when it can be had, reduction by a current of light or heavy carburetted hydrogen gas,* as this reduction takes place at a much lower temperature and is very complete. (Properly managed, the gas given off in this reduction ought, after passing through cold water, to be pure carbonic oxide.) This sponge is then to be ground up with the proper flux, and compressed into small cakes. A basis of richly-carburetted pure pig-iron in fusion having been run out into the con-

* Described under my patent of 1851-2.

verter, the current of burning pyrogen gas, as described by me in former papers, is to be let on for a few minutes, after which the prepared ore is to be gradually added to the bath, the gas current being continued, until the exact degree of cementation of the metal required in the aggregate is attained. The weight of sponge being known, and the degree of its carburation, if any, as well as that of the original metal bath, the proper proportions are easily attained. If the flux have been well adjusted, the cinder or scoria ought to be a perfect glass, free from metallic oxide (save where manganesiferous materials are present), and suitable for glass-making. The heat evolved by the complete combustion of pyrogen is sufficient for the fusion of the prepared ore in a proper furnace without metal; but I hesitate to advise it, because, as it seems to me, it would render more difficult the due degree of cementation, and might corrode the lining of the furnace. In all cases the finery, furnace, or converter must be gradually heated up to the point at which the bath is to be run in, as sudden contractions by heat may injure the lining. The ores which I prefer are the best magnetic or spathose, well calcined, and the same may be generally said as to the metal of the bath; but a splendid basis may be obtained in metal produced from pure brown hematite, such as the ores of the Duc d'Arenberg, which have a happy content in oxide of manganese.

"In the above, I contemplate the production of a high-class workable steel, such, for example, as would require, in the old method of cementation, Russian or other charcoal bars at £20 a ton and upwards. If to this we add the cost of cementation and melting in pots, we get a pretty good margin for the above operations, raw materials included. This steel may be used also for casting articles in moulds, as proposed in my letter above. Axes so made could be worn down to the 'eye' itself, to the joy of the backwoodsman."—*Iron.*

On the Use of Pulverized Fuel.

Written for the ENGINEERING AND MINING JOURNAL.

By Chief Engineer B. F. ISHERWOOD, U. S. Navy.

EXPERIMENTS MADE AT SOUTH BOSTON, MASSACHUSETTS, TO DETERMINE THE ECONOMIC VALUE OF MESSRS. WHELPLEY & STORER'S PROCESS OF BURNING PULVERIZED COAL, MIXED WITH AIR AND FED BY A BLAST TO THE FURNACE ABOVE A BED OF INCANDESCENT LUMP COAL, COMPARATIVELY WITH BURNING LUMP COAL ALONE ON THE GRATES IN THE USUAL MANNER FOR THE GENERATION OF STEAM IN BOILERS.

CONTINUED FROM PAGE 13.

WHEN pulverized coal is used, a brick arch, 4½ inches thick, and 3 feet in length, is sprung over the front portion of the grate. The inside radius of this arch is 3 feet 1½ inches, and its abutments are the sloping portions of the furnace side walls. The front end of this arch joins the front wall of the furnace. From the top of the arch to the bottom of the boiler-shell is 1 inch. When lump coal alone is used, this arch is removed, its object being to prevent the too rapid extraction of the heat from the gases of combustion by the boiler-shell immediately over the grate, and thereby reduce their temperature too low for the ignition of the pulverized coal, which is blown into the furnace between the grate and the arch.

The back smoke-connection is between the back end of the boiler-shell and the back wall. It is of brick masonry, rectangular in form, 6 feet 5 inches high in the clear, 23 inches long in the clear, and 3 feet 8 inches wide in the clear. The top is on a level with the top of the boiler-shell.

The front smoke-connection is of sheet iron, bolted to the front end of the boiler-shell. This connection is rectangular, 18¼ inches high in the clear, and 17¾ inches long in the clear; it is wide enough to embrace the ends of the two flues, and from its center rises, vertically, the chimney, a sheet iron pipe of 18 inches inside diameter.

The following are the principal dimensions and proportions of the boiler, namely:

Extreme length of shell	22 feet 11¼ inches.
External diameter of shell	3 feet 6 inches.
Number of flues	2
Extreme length of flues	22 feet 11¼ inches.
Internal diameter of flues	1 foot 1 inch.
External diameter of flues	1 foot 1¾ inches.
Length of grate	4 feet 6 inches.
Width of grate	3 feet.
Area of grate-surface	13.5 square feet.
Cross area for draught, between boiler-shell and inverted arch beneath it	3.264 square feet.
Cross area for draught through the flues	1.843 square feet.
Cross area of the chimney	1.767 square feet.
Capacity of water room up to 3 inches above top of flues	86.352 cubic feet.
Capacity of steam room above 3 inches above top of flues	82.374 cubic feet.
Diameter of chimney, internal	1 foot 6 inches.
Height of chimney above level of grate	39 feet 5 inches.
Area of water-heating surface in the cylindrical portion of the shell	137.68 square feet.
Area of water-heating surface in the back end of the shell, up to 3 inches above top of the flues	5.68 square feet.
Area of water-heating surface in the flues	156.27 square feet.
Aggregate area of water-heating surface	299.63 square feet.
Ratio of the water-heating to the grate surface	22.195 to 1,000.
Ratio of the grate surface to the cross area for draught, between boiler shell and inverted arch beneath it	4,136 to 1,000.
Ratio of the grate surface to the cross area for draught through the flues	7.325 to 1.000.
Ratio of the grate surface to the cross area of the chimney	7.640 to 1.000.

ENGINE.

A small steam engine is employed for crushing the coal, driving the fan-blowers, and pumping the feed-water into the boiler. The feed-pump is worked by a short counter-shaft, receiving its motion through a belt from the main-shaft of the engine. The pulverizer and fan-blowers are worked by belting from a shaft, 13 feet long, which receives its motion through a belt from the engine main-shaft. There are 90 feet length of belting in all.

The steam-pipe to the engine from the boiler is 1¼ inches in outside diameter, and twenty-one feet in length. It is covered with felt.

The engine is horizontal and non-condensing. The steam valve is of the ordinary three-ported kind, on the back of which is a variable slide cut-off valve connected to the governor. During the experiments the cut-off valve was not used, and the steam was cut off in the cylinder at 0·96 of the stroke of the piston from the commencement by lap on the steam valve.

The diameter of the steam cylinder is eight inches, and the stroke of its piston is two feet. The diameter of the piston rod is 1.7-16 inches.

MANNER OF MAKING THE EXPERIMENTS.

The boiler with which the experiments were made, was in a building on the premises of the patentees in South Boston, Mass. The small steam engine used for working the pulverizer, fan-blowers, and feed pumps was in the same room with the boiler.

The evaporation would have been done under the atmospheric pressure, had it not been for the necessity of steam of higher pressure to work the small steam engine. The pressure under which the evaporation took place was about thirty-one pounds per square inch above the atmosphere, from which it varied but very slightly either in the same or in different experiments.

All the steam generated, with the exception of what was used in the small steam engine, was blown off into the atmosphere through the safety-valve.

The steam-pressure was taken by a mercurial gauge attached to the boiler.

The feed-water, previously to being pumped into the boiler, was accurately measured in a plate iron cylindrical tank, which contained exactly 27·27 cubic feet up to the hole drilled in it for an overflow. The height from the bottom of the tank to the bottom of the overflow hole was 5 feet 10¼ inches. The capacity of the tank was obtained by filling it with water from a standard gallon measure. The thermometer from which the temperature of the feed-water was obtained was suspended by a string near the bottom of the tank where it constantly remained except when temporarily withdrawn for reading.

The temperatures of the external atmosphere in the shade, and of the room containing the boiler and small steam engine, were obtained from thermometers permanently suspended. In this same room a barometer was suspended also. An indicator was permanently attached to each end of the steam cylinder by means of a pipe 6 inches long, fitted with a stop-cock; there were thus two indicators in use.

All the coal consumed, and the refuse from it, were accurately weighed with tested scales and in the same iron tub. This tub was counterbalanced on the scales and filled each time with the same weight, so as to prevent error. The lump coal and the pulverized coal were weighed and noted separately. What is called lump coal was coal in the condition in which it is delivered commercially. In the experiments made with lump coal and with pulverized coal, the proportion of the former was kept as small as possible, the intention being to use as much pulverized coal as practicable, in order to make its effect strongly marked. The fire on the grate-bars was kept four inches thick, clean, well leveled, and free of holes; and both the lump and the pulverized coal were burned with air supplied by the fan-blowers. In the case of the lump coal, the air was delivered beneath the grate-bars into the closed ash-pit, near the center of its bottom, through a tuyere; and in the case of the pulverized coal, it was blown into the furnace through a tuyere, mixed with that coal above the lump coal on the grate-bars.

At the commencement of an experiment, steam was raised to the pressure of thirty-one pounds per square inch above the atmosphere by wood which was then allowed to burn out to the embers required for lighting the lump coal. No account was kept of this wood. The water being now adjusted in the glass water-gauge of the boiler to three inches above the top of the flues, the steam pressure being 31 pounds per square inch above the atmosphere, the time was noted, the coal fired and the experiment was held to commence.

Each experiment continued exactly forty-eight consecutive hours, at the end of which, the coal having been burned out as nearly as possible, the fire was drawn and wetted out, and the unconsumed coal picked out, weighed and deducted from the quantity expended. At the end of the experiment care was taken that the height of the water in the boiler, and the steam pressure upon it, were exactly the same as at the commencement. The furnaces and smoke-connections were then cleared and the flues swept, and the refuse of clinker, dust and ash obtained, were weighed and added to the weight of refuse removed during the experiment from the furnace and ash-pit.

In conducting the experiments a systematic tabular record was kept, in which the following quantities were noted in appropriate columns at the end of every hour: 1st. The number on the engine-counter, and to check any error in taking it, the double strokes made by the engine-piston per minute during that hour were determined, and entered in a parallel column. 2d. The average steam pressure per gauge in the boiler during the hour, the variations in this were very slight. 3d. The proportion of the throttle-valve open; this rarely varied in any one experiment, and only within very narrow limits. 4th. The average height of the barometer during the hour. 5th. The average temperature of the engine-room and fire-room; the average temperature of the external atmosphere in the shade; and the average temperature of the feed-water in the tank, during the hour. 6th. The weight of coal thrown into the furnace during the hour. In another column there was recorded the exact time at which each tankful of water was emptied. This method of noting the tanks not only gave the exact number used, but furnished a check upon error; for the consumption of water was so nearly uniform in its rate during an experiment, that the omission or addition of a tankful would have been instantly detected. The weight of refuse from the coal withdrawn from the furnace and ash pit was entered in its appropriate column at the close of each watch of 4 hours. At the end of every hour the state of the weather was entered in the record. An indicator diagram was taken from each end of the steam cylinder at the end of every hour. There were thus for each experiment forty-eight complete sets of observations arranged in columns, the footings of which gave the total quantities, or the means, as the nature of the results required, and which will be found in the following table.

The experiments were made by a Board of Naval Engineers in strict conformity with the minutely detailed instructions of the writer, to whom the tabular blanks were sent as fast as filled. The engineers stood regular watches of four hours each, as at sea, and personally weighed or noted all the quantities, took the indicator diagrams, and closely superintended every operation.

The quantity of air supplied by the fan-blower to the lump coal was regulated by the registers on its receiving apertures.

The thickness of the bed of lump coal on the grate was raised from four to six inches, without sensibly affecting the results.

When the experiments with the lump coal alone were made, the brick arch over the grate bars was removed from the furnace.

The experiments were made with Pennsylvania anthracite, and with semi-bituminous coal from the Cumberland mines of Maryland. Both kinds of coal were of the very best quality, giving a remarkably small per centum of refuse.

There were two rates of combustion adopted: one was 12 pounds of coal per square foot of grate-surface per hour; the other was the maximum rate that could be obtained without too great a sacrifice of the economic result. In the pulverized coal experiments, the twelve pounds of coal consumed per hour per square foot of grate-surface included both the pulverized and the lump coal.

With each kind of coal five experiments were made, two at the maximum rate of combustion, and the remaining three at the rate of about 12 pounds of coal per square foot of grate-surface per hour. No air was admitted through perforations in the furnace-door.

TABLE containing the data and results of the experiments made at South Boston, Massachusetts, to determine the relative economic value of turning lump coal alone in steam-boilers in the usual manner, and of burning pulverized coal mixed with air, and fed to the furnaces by a blast above a bed of incandescent lump coal on the grate-bars, according to the process of Messrs. WHELPLEY and STORER:

No. of Line.		Using Anthracite.					Using Semi-Bituminous Coal.				
		Burning Lump Coal alone.			Burning Lump and Pulverized Coal.		Burning Lump Coal alone.		Burning Lump and Pulverized Coal.		
		Admitting the quantity of air which gave the highest evaporative results.		Admitting the least quantity of air that would consume the anthracite.	Admitting the quantity of air which gave the highest evaporative results.		Admitting the quantity of air which gave the highest evaporative results.		Admitting the quantity of air which gave the highest evaporative results.		
			Maximum Combustion			Maximum Combustion		Maximum Combustion			Maximum Combustion
		A	B	C	D	E	F	G	H	I	J
	DATE OF THE EXPERIMENT....	5 P.M., Jan. 5, 1869	Noon, Jan. 13, 1869,	Noon, Feb. 2, 1869	2 P.M., Jan. 25, 1869	7 P.M., Jan. 27, 1869	4 P.M., Nov. 17, 1868	10 P.M., Dec. 1, 1868	10 P.M., Dec. 9, 1868	3 P.M., Dec. 17, 1868.	4 P.M., Dec. 28, 1868.
	TOTAL QUANTITIES.										
1	Duration of the experiment, in consecutive hours	48.	48.	48.	48.	48.	48.	48.	48.	48.	48.
2	Number of double strokes made by the piston of the blowing-engine	211,577.	209,474.	213,094.	202,619.	206,324.	206,008.	204,036.	185,539.	212,202.	209,938.
3	Number of cubic feet of water pumped into the boiler	768.031	882.917	680.223	661.656	859.902	899.937	1,096 430	845.370	1,009.020	1,127.194
4	Number of pounds of water pumped into the boiler	47,915.049	55,083.364	42,434.293	41,275.839	53,647.452	55,136.898	68,399.964	52,740.906	62,950.102	70,323.005
5	Number of pounds of coal consumed in the lump state	7,590.	9,605.5	7,622	5,271.	6,943.	7,643.5	9,502.0	2,688.	3,136.	3,975.
6	Number of pounds of coal consumed in the pulverized state	.....	.....	.....	2,495.	3,420.	.....	.....	4,116.	4,704.	6,375.
7	Aggregate number of pounds of coal consumed in the lump and in the pulverized state	7,590.	9,605.5	7,622.	7,766.	10,363.	7,643.5	9,502.0	6,804.	7,840.	10,350.
8	Number of pounds of refuse from the coal, in ash clinker, and soot	962.	996.5	942.	1,178.	1,449.	978.0	926.5	612.	669.	724.
9	Aggregate number of pounds of combustible consumed in the lump and in the pulverized state	6,628.	8,608.	6,680.	6,588.	8,914.	6,665.5	8.575.5	6,192.	7,171.	9,626.
10	Per centum of the coal in refuse of ash, clinker and soot	12.67	10.37	12.36	15.17	13.98	12.80	9.75	9.00	8.53	7.00
11	Per centum consumed in the lump state of the total weight of coal consumed	100.	100.	100.	67.87	67.00	100.00	100.	39.51	40.00	38.40
12	Per centum consumed in the pulverized state of the total weight of coal consumed	.....	.....	.....	32.13	33 00	.....	.....	60.49	60.00	61 60
	RATE OF COMBUSTION.										
13	Pounds of coal consumed per hour	158.125	200.094	158.792	161.792	215.896	159.240	197.958	162.000	163.333	215.625
14	Pounds of combustible consumed per hour	138.083	179.333	139.167	137.250	185.708	138.864	178.656	147.429	149.396	200 542
15	Pounds of coal consumed per hour per square foot of grate-surface	11.713	14.822	11.762	11.984	15.992	11.795	14 664	12.000	12.099	15.972
16	Pounds of combustible consumed per hour per square foot of grate-surface	10.228	13.284	10.309	10.167	13.756	10.286	13.234	10.921	11.066	14.855
17	Pounds of combustible consumed per hour per square foot of heating surface	0.461	0.598	0.464	0.458	0.620	0.463	0.596	0.492	0.499	0.669
	BLOWING-ENGINE.										
18	Number of double strokes of the piston of the blowing-engine made per minute	73.464	72.734	73 991	70.354	71.640	71.530	70.846	73.626	73.681	72.893
19	Steam pressure in boiler, in pounds per square inch above the atmosphere	31.37	31.04	30.50	30.10	30 83	30 27	31.03	31.26	31.48	30.96
20	Fraction of the stroke of the piston at which the steam is cut off	0.96	0.96	0.96	0.96	0.96	0.96	0 96	0.96	0.96	0 96
21	Proportion of the throttle-valve open	0.04	0.04	0.04	0.09	0.10	0.04	0.04	0.07	0 06	0 07
22	Barometer, in inches of mercury	30.08	30 34	30.16	30.50	30.19	30.27	30.03	30.20	30.36	30 37
23	Mean gross effective pressure on piston, in pounds per square inch, per indicator	5.37	5.96	5 87	14.36	15.98	5 27	5 44	10.10	8.95	10 02
24	Mean net pressure on piston, in pounds per square inch per indicator.	2.33	2.92	2.83	11.32	12 94	2.23	2.40	7.06	5.91	6 98
25	Gross effective indicated horses-power developed by the blowing-engine.	2.331	2.562	2.567	5.970	6.765	2.228	2 277	4.394	3.897	4 316
26	Net indicated horses-power developed by the blowing-engine	1.011	1.255	1.337	4.706	5.478	0.943	1.005	3.072	2.573	3 007
	TEMPERATURES.										
27	Temperature, in degrees Fahrenheit, of the external atmosphere	35.1	33.6	31.2	18 3	34.4	38.9	22.8	22.6	27.4	31.2
28	Temperature, in degrees Fahrenheit, of the engine-room and fire-room	67.3	65.3	58.3	52.6	64.8	56.2	66.1	64.0	75.1	69.4
29	Temperature, in degrees Fahrenheit, of the feed-water in the tank	42.0	40.0	45.2	42.0	41.6	47.4	44.1	39.8	41.2	40 6
	VAPORIZATION—ABSOLUTE.										
30	Total number of pounds of water that would have been vaporized in the boiler, had it been supplied at the temperature of 100 degrees Fahrenheit, and vaporized under the atmospheric pressure of 29.92 inches of mercury.	50,448.986	58,096.945	44,555.333	43,459.540	56,504.597	57,781.435	71,886.810	55,683.813	66,324.646	74,132.009
31	Total number of pounds of water that would have been vaporized in the boiler, had it been supplied at the temperature of 212 degrees Fahrenheit, and vaporized under the atmospheric pressure of 29.92 inches of mercury.	57,360.868	66,051.781	50,644.100	49,394.105	64,234.616	65,701.806	81,724.889	63,311.752	75,418.616	84,280.195
	ECONOMIC.										
32	Pounds of water vaporized from 100 degrees Fahrenheit, by one pound of coal	6.647	6.048	5.846	5.596	5.452	7 560	7.565	8.184	8.460	7.162
33	Pounds of water vaporized from 100 degrees Fahrenheit, by one pound of combustible	7.611	6.749	6.670	6.597	6 339	8.669	8 383	8.993	9.249	7.701
34	Pounds of water vaporized from 212 degrees Fahrenheit, by one pound of coal.	7.557	6.876	6.644	6.360	6.198	8.596	8.601	9.305	9.620	8.143
35	Pounds of water vaporized from 212 degrees Fahrenheit, by one pound of combustible	8.654	7 673	7.581	7 498	7.206	9 857	9.530	10.225	10.517	8 755

RESULTS OF THE EXPERIMENTS.

In the preceding table are the data and results of the different experiments, arranged in parallel columns and lettered for facility of reference. For the same purpose, the quantities are arranged in groups.

Experiments A to E, both inclusive, were made with anthracite. Of these experiments, A, B, and C, were made with lump anthracite alone; and D and E were made with pulverized anthracite mixed with air and blown into the furnace above the bed of incandescent lump anthracite on the grate-bars.

Experiment C varied from experiment A, only in being made with the admission of the least possible quantity of air that would consume the intended quantity of anthracite. Experiments B and E were made with the maximum rate of combustion that could be maintained without too great a sacrifice of calorific effect, the remaining experiments A, C, and D, were intended to be made at the uniform rate of combustion of 12 pounds of anthracite per square foot of grate-surface per hour, a rate that was sufficiently closely approximated.

Experiments F to J, both inclusive, were made with the semi-bituminous coal from the mines of Cumberland, in the State of Maryland. Of these experiments, F and G were made with lump coal alone, and H, I, and J were made with pulverized coal mixed with air and blown into the furnace above the bed of incandescent lump coal on the grate-bars.

Experiment I, was a repetition of experiment H. Experiments G and J were made with the maximum rate of combustion that could be maintained without

too great a sacrifice of calorific effect; the remaining experiments, F, H, and I were intended to be made at the uniform rate of combustion of 12 pounds of coal per square foot of grate-surface per hour.

In all the experiments, except C, the quantity of air admitted to the furnace proportionally to the coals, was that which was considered as giving the highest calorific effect. Of course, this quantity of air could not be determined with any accuracy. There was no way of ascertaining, except by not very satisfactory trials, what was the best quantity of air to deliver in each experiment with the coal, and, although this quantity was graduated by the more or less closing of the registers on the receiving openings of the fan-blowers, yet there was no means of determining either the absolute or relative quantities of air proportional to weight of coal consumed, that were really delivered into the furnace in the different experiments. There was, indeed, no way of discovering if the intention of the patentees to admit only the quantity of air rigorously required for the combustion, was fulfilled in the conduct of the experiments.

In the rates of combustion in pounds of coal burned per hour, and per square foot of grate-surface and heating-surface, given when pulverized coal was used, is included the quantity of pulverized coal as well as of coal consumed in the lump state. Of course, the pulverized coal was not burned on the grate-bars, but in the furnace above them, and in the state of a thick dust intimately mixed with air; but the most convenient mode of expressing its rate of combustion for general comparison, is by what would have been its rate, if it had been burned on the grate-bars.

As no comparable experiments were made with the brick-arch over the grate-bars in the furnace, in place and removed, nothing was determined of its effect. The patentees considered it essential to the success of their process of burning pulverized coal, but their opinion has no weight in the absence of experimental proof. It is to be regretted that the number of experiments made was so limited, that this point, as well as some others of interest, was left undecided.

The facts determined by these experiments for the experimental boiler and conditions, are:

1st. The relative economic value of anthracite and semi-bituminous coal consumed wholly in the lump state at equal rates of combustion; and partly in the lump and partly in the pulverized state, also, at equal rates of combustion.

2d. The proportion of the total weight consumed of anthracite and semi-bituminous coal, which could be consumed in the pulverized state.

3d. The relative economic value of anthracite consumed wholly in the lump state, or partly in the lump and partly in the pulverized state.

4th. The relative economic value of semi-bituminous coal consumed wholly in the lump state, or partly in the lump and partly in the pulverized state.

5th. The relative economic value of anthracite, both in the lump and in the pulverized state, when burned at the maximum rate of combustion, and when burned at the rate of about 12 pounds per hour per square foot of grate-surface.

6th. The relative economic value of semi-bituminous coal, both in the lump and in the pulverized state when burned at the maximum rate of combustion, and when burned at the rate of about 12 pounds per hour per square foot of grate-surface.

7th. The relative economic value of anthracite in the lump state when burned with as little air as practicable, and when burned with an air admission that gave the highest evaporative effect.

8th. The relative economic value of anthracite, when burned in the pulverized state alone at the maximum rate of combustion, and when burned at the rate of about 12 pounds per hour per square foot of grate-surface.

9th. The relative economic value of semi-bituminous coal when burned in the pulverized state alone at the maximum rate of combustion, and when burned at the rate of about 12 pounds per hour per square foot of grate-surface.

By economic value is meant the number of pounds of water vaporized under the atmospheric pressure from the temperature of 212 degrees Fahrenheit, by one pound of the combustible portion of the coal; that is, by the portion which remains after the refuse in ash, clinker, and soot have been deducted. This quantity is given on the last line of the table.

10th. The gross effective and the net horses-power developed by the steam-engine for working the pulverizing mill and the blowing fans.

11th. The weight of coal required per hour for working the pulverizing mill and the blowing fans; and its per centum of the total weight consumed per hour.

12th. The weight of coal required per hour for working the pulverizing mill alone; and its per centum of the total weight consumed per hour.

13th. The weight of coal required per hour for working the blowing fans alone; and its per centum of the total weight consumed per hour.

TO BE CONTINUED.

Consolidated Virginia.—Speaking of the situation at the Consolidated Virginia mine, the Gold Hill *News*, of Dec. 15th, says: The Consolidated Virginia Mining Company resumed the hoisting of ore through the Consolidated shaft to-day.

The Northern Belle Mill and Mining Company advertise for proposals for the building of a 20-stamp mill, dry crushing, Stetefeldt Furnace, of the same capacity as the furnace now in use by this company at Belleville, Esmeralda County, Nevada.

"Centennial" Blow at the Bethlehem Steel Works.—On the night turn, Dec. 31, 1875, and January 1, 1876, there was blown at the Bethlehem Iron Co.'s Bessemer Steel Works, what is believed to be the largest heat of steel ever made in this country. This heat was the first in the new year, and weighed in steel ingots eighteen thousand five hundred and fifty (18,550) pounds!! This was blown in an ordinary "five-and-a-half-tons" vessel; the blast pressure was twenty-four pounds, and the "blow" occupied twenty-one minutes.

The New Coso District, in Inyo County, Cal., appears to begin to verify some of the splendid prophecies, uttered by the press in regard to it during the last year. The Defiance Mine, which is reported to be the largest lead-silver-ore deposit yet discovered, has been opened to a sufficient depth to supply regularly the furnace (25 tons capacity, we believe,) which has been built during the summer. The Independent is another large deposit in the same vicinity, which is said to be almost equal in value to the Defiance. The superintendent of the New Coso Company, says, under date of Dec. 18: "Furnace running nicely; production last 48 hours 255 bars. Have commenced mining dry ore with our heavy lead ores, which so far has been highly successful, having not, as yet, experienced the slightest difficulty; the result is very gratifying, as it will enable us to utilize a vast amount of ore hitherto considered as unavailable for smelting. Have started a winze on 90-foot level—Lucky Jim—to connect with the cross-cut for 137-foot level; the ore extracted in sinking is very good; the middle stopes are yielding ore high in lead and silver." Under date of the 20th inst., writes: "During last 24 hours we have produced 265 bars, (value $5,000 approximately) and have had a single stoppage since we started up. The winze from 90-foot level has been sunk six feet; the entire bottom (five feet wide) is in high grade silver ore. At the Christmas Gift we resumed sinking yesterday; the shaft is in good ore the whole width of the bottom. Shipped you to-day 170 bars."

Coal and Metal Trades of Boston, 1875.

COAL.

The highest and lowest prices of anthracite and provincial coal for ten years past have been as follows:—

	Anthracite, per ton.	Nova Scotia, per ton.		Anthracite, per ton.	Nova Scotia, per ton.
1875	$7 00@ 9 00	$5 25@6 25	1870	$7 00@11 00	$5 75@7 25
1874	7 00@ 9 00	5 75@7 75	1869	7 50@11 00	7 25@9 00
1873	8 00@10 00	7 00@9 00	1868	7 00@12 00	7 50@9 00
1872	7 00@10 00	6 00@8 50	1867	7 50@10 00	7 25@9 25
1871	7 00@10 00	5 75@7 00	1866	9 00@15 00	7 50@9 50

The imports of foreign and domestic coal at this port for ten years past have been as follows:

From	Foreign, tons	Domestic, tons.	From	Foreign, tons.	Domestic, tons.
Great Britain	2,738	....	Total, 1874	51,438	1,125,516
Provinces	29,706	....	1873	87,700	1,076,673
Philadelphia	....	623,245	1872	90,739	1,068,781
Alexandria	....	97,697	1871	109,013	822,808
Baltimore	....	168,798	1870	115,022	819,890
Georgetown	....	20,567	1869	110,469	764,017
Other places	....	290,271	1868	103,901	742,481
Total, 1875	32,444	1,200,578	1867	117,440	680 221
			1866	159,380	676,376

COPPER.

The highest and lowest price for ten years has been as follows:—

	Sheathing Copper.	Metal.	Ingot Coper.
1875	—@30	21 @22	21¼@23½
1874	30@33	22 @25	19 @26
1873	33@43	26 @27	21 @35
1872	34@43	24 @30	27 @40
1871	30@34	22 @24	21¼@27½
1870	30@32	22 @27	18⅓@22¾
1869	32@33	25 @27	21¼@27
1868	29@39	25 @26	21 @24½
1867	32@40	19½@30	21 @29
1866	40@55	30 @40	26 @42

THE IRON TRADE.

The effects of the depression are more clearly seen in the iron trade than in any other branch. Prices of pig and bar have steadily declined during the year, and have now reached a point considerably below the cost of production. What was, a few years ago, one of the most lucrative and important industries in the country has become the least noticeable and unremunerative. Scotch pig has almost entirely disappeared from the market, the imports during the year having been only 1504 tons against 2775 tons in 1874, and 11,101 tons in 1873. Prices of American pig declined about $5 per ton during the year, opening at $30@32 for No. 1 brands and closing at $25@27. Refined bar opened at $60@$62 and closes at $52@54 per ton; a decline of $8 per ton. Rails have been in very limited request, not enough doing to form a basis for prices. It is not reasonable to suppose that the depression in this business can continue much longer. This is still an iron age, and as iron was the first to feel the effects of the panic, it will be sure to take the lead in the revival which is, we hope, near at hand.

IRON.

The highest and lowest prices of American pig iron, for the past three years, have been as follows:

1875, per ton	$24 00	@	$32 00
1874 "	27 00	@	41 00
1873 "	32 00	@	59 00

The range of prices of American and English bar iron and Russia sheet iron for ten years has been as follows:

	Bar.	Russia Sheet.		Bar.	Russia Sheet.
1875	$50 00@ $62 50	14 @17	1870	$70 00@ $90 00	11½@14½
1874	55 00@ 80 00	16 @18	1869	80 00@ 100 00	10⅝@13⅞
1873	75 00@ 110 00	18 @21	1868	85 00@ 105 00	11 @14
1872	85 00@ 120 00	17 @22	1867	85 00@ 120 00	15 @20
1871	70 00@ 95 00	12 @20	1866	100 00@ 130 00	20 @40

The imports have been as follows:

	Great Britain.	From Sweden.	Coastwise.		Great Britain.	From Sweden	Coastwise.
Bars	416,921	102,429	278,269	Bundles	37,027	5,713	133,404
" tons	....	1,255	1,473	Plates	214	....	30,430
RR bars	6,899	....	2,233	Scrap, tons	590	....	532
" tons	1,382	....	240	Pig, tons	2,170	....	10,332

The imports for three years past have been as follows:

	1875.	1874.	1873.		1875.	1874.	1873.
Bars	797,619	1,213,367	1,193,170	Bundles	176,745	317,420	253,153
" tons	2 728	2,553	12,062	Plates	30,644	70,523	60,824
RR. bars	9,132	30,625	19,783	Scrap, tons	1,122	3,075	6,467
" tons	1,622	2,739	1,243	Pig, tons	12,502	19,199	30,386

LEAD.

The imports of the year, foreign and coastwise, have been as follows:

1875, pigs	39,138	1870, pigs	48,350
1874 "	100,472	1869 "	58,230
1873 "	82,869	1868 "	81,767
1872 "	68,357	1867 "	60,828
1871 "	78,102	1866 "	54,482

TIN.

The imports have been as follows:

	Tin. pigs.	Tin Plates. boxes.		Tin. pigs.	Tin Plates, boxes.
1875	16,334	199,424	1870	43,164	149,245
1874	14,044	129,080	1869	42 309	114 061
1873	43,036	128,278	1868	47.647	15,158
1872	57,631	117,699	1867	11,592	100,874
1871	54,967	155,566	1866	28,624	102,037

—Boston *Shipping List.*

The Oakland Quicksilver Company shipped twenty-one flasks of quicksilver, on the 14th Dec., and nineteen flasks on the 18th. Their new furnace, recently erected, is doing good work.

The Bay City Tunnel Company of Little Cottonwood District, Utah, has struck an ore body which is supposed to be the Equitable ore body. It is said to assay from $2000 to $4000 silver per ton.

Illuminating Gas.

Address by Prof. CHANDLER, before the Gas-Light Association.

CONTINUED FROM PAGE 12.

The loss of light by the use of shades, chimneys, etc., is very considerable and largely due to the conversion of light into heat. The following numbers, selected from the results of WILLIAM KING, of Liverpool, and Prof. F. H. STORER, of Boston, are a sufficient illustration :

DESCRIPTION OF GLASS.	Thickness of Glass	Loss of Light.
Clear glass (King	———	10.57
Ground glass "	—— ——	29.48
Smooth opal "	———	52.82
Ground opal "	———	55.85
Thick English plate (Storer)	$\frac{1}{8}$ inch	6.15
Crystal plate "	$\frac{1}{4}$ "	8.61
English crown "	$\frac{1}{4}$ "	13.08
Double English window "	$\frac{1}{8}$ "	9.39
Double German (Belgian) Storer	$\frac{1}{8}$ "	13.00
Single German (Belgian) "	$\frac{1}{4}$ "	4.27
Double " (Belgian) ground (Storer)	$\frac{1}{8}$ "	62.34
Single " " " "	1-16 "	65.75
Berkshire, Mass., ground (Storer)	1-16 "	62.74
Orange-colored window glass (Storer)	1-16 "	34.48
Purple " " " "	$\frac{1}{4}$ "	85.11
Ruby " " " "	1-16 "	89.62
Green " " " "	1-16 "	81.97
A porcelain transparency	1-16 "	97.68

Lighting Gas by Electricity has recently been introduced in theaters, halls, etc., with great advantage. As it is an instantaneous operation, it results in great economy by rendering it unnecessary to light the gas before it is actually wanted, and in sparing the attendants the great exertion required in applying the torch at great heights. It may be effected by stretching a fine platinum wire above each burner, and heating it to a white heat by a current of electricity when the gas is turned on. A better plan is to use the Ruhmkorff coil. In this case each burner is isolated from the house-pipes by a hard rubber connecting ring. A series of wires is then arranged by which the electric current is made to leap in sparks to the tip of each burner in succession when the gas is turned on. Systems have been invented by which the gas of the street-lights is turned on and off and lighted by electricity from a central office.

Pressure.—As already stated, a certain amount of pressure is required to force the gas through the street-mains, house meters, pipes, and burners. The pressure is measured by the height of a column of water supported by the gas in a U-shaped tube, one end of which is open to the air, while the other is connected with the gas supply. It is estimated that there should be a pressure of one inch at the entrance to the premises of every consumer, 0.2 inch being required to force the gas through the meter, 0.2 inch for the house-pipes, and 0.6 inch for the burners. This pressure is exerted by the weight of the great gas-holders at the works. Were the consumption of gas uniform during the entire twenty-four hours, the holder could be properly balanced once for all, and a uniform pressure would be exerted at all times—four or five inches are found to be necessary for large districts—but when no gas is burned, no pressure is required, and when little gas is burned, four or five inches would be excessive. Consequently, the pressure must be graduated according to the hourly consumption. For this purpose the *governor*, already mentioned, is employed at the works to regulate the flow, and consequently the pressure, of the gas from the holder to the street-mains. The following table exhibits the variation in pressure caused by irregularities of consumption. The holders of the New York Gas Light Co. are on East 21st street; its district extends from Grand street to the lower end of the island at Whitehall street; Hester street is well within the district.

PRESSURE OF THE GAS IN INCHES OF WATER.

	3 P.M.	4 P.M.	5 P.M.	6 P.M.	7 P.M.	10 P.M.	12 P.M.
21st street	1.7	2.	5.5	4.2	2.9	1.9	1.0
Hester street	1.6	1.7	2.4	2.2	1.9	1.6	1.2
Whitehall street	1.0	1.	0.6	1.1	1.1	1.0	0.8

It is thus seen that a uniform pressure throughout the district supplied is absolutely impossible. In order to secure a sufficient pressure at the extremities of the district, an excessive pressure must be produced at the intermediate points; and as the pressure must be varied from hour to hour at the works, it will vary at the premises of most of the consumers. The consumer must therefore regulate the pressure for himself; 1st, by carefully adjusting the main cock at the meter; 2nd, by adjusting the cock at each burner; 3rd, by using check burners; 4th, by attaching a regulator at the meter. It sometimes happens that the consumer cannot get sufficient pressure to supply his burners, when he of course fails to get the light he requires, and concludes that the gas is poor. This difficulty may be due to several causes: 1st, insufficient pressure at the works; 2nd, the street-mains are too small or are obstructed; 3rd, the service pipe is too small or obstructed; 4th, the meter is too small or out of order; 5th, the house-pipes are too small or obstructed; 6th, the fixtures are obstructed; 7th, the burners are too small, defective, or obstructed. By comparing notes with neighboring consumers, and consulting an intelligent gas-fitter, the real cause of the deficient light can generally be ascertained. In large buildings there should be a separate cock and regulator on each floor to prevent irregularity of pressure.

The illuminating power of gas is dependent upon several conditions: 1st, liberation of solid particles of carbon from the olefiant gas and rich hydrocarbon vapors by the heat of the flame, or the oxidation of the hydrogen at points in the flame where the supply of oxygen is not sufficient for both hydrogen and carbon; 2nd, to the temperature of the flame, which renders the carbon particles luminous; 3rd, to the density of the materials burned; 4th, to the density of the products. These conditions depend upon the chemical composition of the gas and the manner of its combustion. Gases rich in olefiant gas and heavy hydrocarbons furnish the most luminous flames. The character of the burner, the dimensions of the chimney with argands, and the pressure determine the manner of combustion by regulating the supply and admixture of air. A low pressure with a burner that secures a supply of air sufficient to prevent smoking—*i.e.*, the escape of unconsumed carbon—secures the maximum amount of light. The pressure and quality of the gas being fixed, it was formerly supposed that the light produced was directly as the rate of combustion, and that consequently two like burners consuming each 3 ft. of gas per hour would give the same amount of light as one similar burner consuming 6 ft. Recent investigations make it extremely probable that the amount of light increases as the square of the consumption. (*Farmer's Theorem.*) Consequently, the light from the two burners would be $3\times3+3\times3=18$, while that from the six-foot burner would be $6\times6=36$. Thus, the large burner gives twice as much light for the same consumption as the two small burners; hence, the economy of a few large burners over many small ones.

Carburetting or Carbonizing Gas.—It having been established that the illuminating power of gas depends upon the presence of heavy hydrocarbon vapors, numerous means have been contrived and patented for adding such vapors to the gas. The materials available are the naphtha of coal-tar, and the naphtha of petroleum or coal-oil. Coal-tar naphtha is by far the most effective, though most expensive. It consists of benzol, C_6H_6, and its homologues, which are very dense and very rich in carbon. Petroleum and coal-oil naphtha consist of hydrocarbons of the marsh-gas series (see petroleum), such as quintane, C_5H_{12}; sextane, C_6H_{14}; heptane, C_7H_{16}, etc., in which the ratio of carbon to that of hydrogen is less than half what it is in benzol, etc. Dr. LETHEBY (*Chem. News*, xi., 1865, p. 126) found that while 1 grain per cubic foot of gas of some naphthas increased the illuminating power 9 per cent., the same quantity of other naphthas raised it only 1.99 per cent. Under favorable circumstances he found that a gallon of coal-tar naphtha would enrich 6,000 feet of gas, adding over 10 grains per cubic foot and increase its illuminating power 68 per cent., thus making it equal to 10,000 feet of the original gas. The practical gain is 4,000 feet, costing the price of 1 gallon of naphtha, about $1. The conditions which effect the carbonization are, 1st, quality of the gas, 2d, quality of the naphtha, 3d, construction of the carburetter, 4th, temperature of the carburetter. The last condition is very essential to success. If the carburetter is placed in a warm situation the naphtha evaporates too rapidly, the gas becomes overcharged, and the flames smoke. The burners must be adjusted to the character of the gas, and if the gas varies from day to day from irregularity in the carbonization, the annoyance becomes intolerable. Another difficulty arises from the condensation of the naphtha in the house pipes and fixtures, by which they become obstructed and cease to deliver gas. These difficulties have led to the ill-success which has attended this apparently logical method of enriching gas.

The Specific Gravity Test.—As already stated, the chief diluents of coal-gas are hydrogen, specific gravity 0.069, and marsh-gas, 0.559, while the luminants are olefiant gas, 0.976, propene, 1.49, butene, 1.94, benzol, 2.71, naphthalene, 4.43, etc. The specific gravity of the mixture will depend, to a certain degree, on the ratio of heavy luminants to light diluents. This does not hold true in the presence of any considerable quantity of carbonic oxide, specific gravity 0.967, as when water gas is a component, or of air, as in the Rand and Gale naphtha gas. The table which you see before you, and which is from MUSPRATT'S "Chemistry," will sufficiently illustrate the relation of specific gravity to illuminating power in coal-gas made by the usual process. The specific gravity was formerly determined by carefully weighing the gas in a light glass globe provided with a stop cock, making suitable corrections for temperature and pressure. Recently, a very simple method has been introduced, by which the operation can be accurately performed in a few minutes. The diffusive power of gases being inversely as the square of the density, the density will be directly as the square of the diffusion. It is only necessary to determine the number of seconds required for equal volumes of air and of the gas to escape through the same opening, and to divide the square of the gas-seconds by the square of the air-seconds; the result is the specific gravity of gas.

As the square of air-seconds is to the square of gas-seconds, so is 1 (sp. gr. of air) to x (sp. gr. of gas).

W. W. GOODWIN, Esq., of Philadelphia, supplies the simple apparatus for this determination under the name of the "density test." (See *Am. Chemist*, ii., 177, 216.)

Name of coal.	Cubic ft. of gas per 2240 lb.	Illuminating power in candles.	Sp. gr. of the gas.
1, Ponesfield	10,500	11.50	.398
2, Gosforth	10,000	12.00	.402
3, New Pelton	10,500	12.00	.415
4, West Hartley	10,500	12.50	.420
5, Pelaw	11,000	12.75	.420
6, Hasting's Hartley	10,300	12.50	.421
7, Leverson	10,800	12.50	.425
8, Pelton	11,000	14.00	.430
9, Washington	10,000	14.00	.430
10, Dean's Primrose	10,500	13.50	.430
11, Blenkinsop	9,700	14.00	.450
12, Washington cannel	10,500	18.00	.500
13, Pelton cannel	11,500	18.50	.521
14, Leverson cannel	11,600	18.00	.523

Gas from Coal Tar.—Ever since the manufacture of coal-gas became an established industry the importance of converting the tar into gas, or of so conducting the destructive distillation as to prevent its formation, has been fully recognized, and the greatest variety of processes has been patented, all of which claim to make *more gas and better gas* from a ton of coal. The actual possibilities are estimated by comparing the weight of tar with the weight of gas from the same coal; 2,240 pounds of average caking coal yield from 9,000 to 10,000 cubic feet of gas of a specific gravity of, say, 0.430, equivalent to 296.86 or 329.84 pounds of gas. The same coal yields, say, 12 United States gallons of tar, the specific gravity of which is from 1.12 to 1.15, or 9.33 to 9.58 pounds per gallon, equal to 112 to 115 pounds. If this tar could be entirely converted into gas of .430 specific gravity, it would add 3,394 to 3,488 cubic feet to the yield of gas. The case is still more striking when, as in some cities in England and Scotland, cannel coal is exclusively employed, cannel coal yielding 10,000 cubic feet of gas having a specific gravity of .500, or 383.5 pounds of gas, yields, say, 30 gallons of tar, specific gravity 0.990, or 247.38 pounds of tar, which, if converted into gas of specific gravity .500, would add 6,449 feet to the yield of gas. The proportion of carbon in coal tar is so great, however, that under no system can it be converted into gas without the formation of a considerable proportion of fixed coke, probably from 25 to 40 per cent. of its entire weight. This fact reduces very considerably the possible gain of gas from the tar; in the case of caking coal, the usual material, from the 3,394 to 3,488 cubic feet of gas to not much above 2,000 feet. To secure this gain, the tar, which has a market value of from 33 to 50 cents per ton of coal, must be sacrificed, and more complicated apparatus and a larger consumption of fuel and labor must be resorted to. It is for these reasons that none of the methods suggested for producing gas from the tar have as yet been successful.

In 1818, JOHN GRAFTON patented the conversion of the tar into gas by delivering it into a second retort, heated to redness and filled with iron filings, coke, etc. In 1820 Mr. LOWE contrived an arrangement of five retorts—three below

and two above—for the same purpose. The retorts were charged in the usual way with coal, and when the carbonization had gone on for three hours, the tar was admitted into the back part of the upper hotter retorts by a syphon tube. Some have mixed the tar with small coal; others with peat, sawdust, porous stones, etc. In 1827, BERNARD CHAUSSENOT patented in France the use of one vessel or retort heated to a low temperature for distilling "resin and all hydrogenous matters, liquid and solid," into rich vapors, and a second retort heated to a high temperature for converting these vapors into permanent gas. This principle has been the basis of numerous patents — ROBERTSON (in 1848), GESNER (1849), HANSON (1853), GALE (1858), FRYER (1868), EVELEIGH (1870?), etc. While this principle has not been successful if applied to coal alone, it is probably essential to the production of gas from petroleum or any of its products, and is in successful operation in several works where petroleum naphtha is used as an enricher for coal-gas, as at the Harlem and the Mutual works in New York, the Citizens' and the People's works in Brooklyn, and many others. This is, after all, but a sub-division of the process which actually takes place in every coal retort, as I have already stated. The coal is always distilled at a low heat, and the condensable vapors are subsequently converted into permanent gas after they leave the coal.

By-Products of the Coal-Gas Industry.—The by-products of the manufacture of coal-gas consist of (1) coke, (2) ammoniacal liquor, (3) tar, (4) the spent lime or oxide of iron used in purification. The *ammoniacal liquor* is the source of nearly all the ammonia salts of commerce. By far the larger part of the nitrogen of the coal, which varies from less than 1 per cent. to nearly 2 per cent., is not converted into ammonia; it forms cyanides, sulpho-cyanides, bases, etc. The strength of the ammonical liquor depends chiefly upon the amount of water used in washing and scrubbing the gas. The strength of the liquor is estimated in degrees (Twaddle), or by the number of ounces of oil of vitriol required to neutralize a gallon. Each degree of Twaddle is equal to about two ounces of acid per imperial gallon. The liquor varies from 3 deg. Twaddle to 10 or 11 deg. Twaddle. The maximum yield of ammonia is perhaps 45 gallons of 8-ounce liquor per ton of coal, equivalent to 34 pounds of sulphate of ammonia. The ordinary yield is about 25 gallons of 8-ounce liquor, equivalent to 20 pounds of sulphate of ammonia. In London only about half this quantity is obtained. In 1866 there were obtained at the Paris gas-works 3,000 tons of ammoniacal products, either sulphate or aqua-ammonia, from 421,000 tons of coal, or 0.712 per cent., or 16 pounds per ton. The ammoniacal liquor contains the ammonia in the form of hydrosulphate, acid carbonate, cyanide, sulpho-cyanide, chloride, and benzoate. By mixing it with lime and blowing steam through it, the ammonia is expelled, and conducted to vats containing sulphuric acid, where it is absorbed and combined as sulphate, which is obtained in crystals on evaporation. This salt is used as a fertilizer, in the manufacture of alum, and for the preparation of other ammoniacal compounds.

The Tar.—The quantity of tar obtained from a ton of coal, varies with the character of the coal, and the temperature to which it is exposed. The higher the heat the smaller the yield of tar. Eleven to eighteen United States gallons is the usual yield from caking coals, the average being about twelve gallons. The Paris gas-works averaged 12¼ United States gallons in 1866. Formerly there was no market for the tar, and it was thrown away. Of late years many uses have been found for it, and it has been a source of revenue to the gas companies. It is used as a rough paint or varnish for wood and iron, for water-proofing paper and felt tor roofing and other purposes, for the manufacture of pitch for roofing and paving, and for the preparation of a great variety of useful and beautiful products. In fact coal tar is one of the richest sources of valuable products known to the chemist, and its study has yielded an extremely rich harvest, both to theoretical as well as to practical chemistry, and has exerted a controlling influence on some of the most useful arts, and even upon the agriculture of large districts.

Coal-tar is a very complex mixture of organic bodies, and consists largely of what are called aromatic compounds. Let me again call your attention to the diagram which shows the more important products from coal. Under the heading tar you see nearly forty hydrocarbons, eight alcohols, four acids, twenty-one bases, and no one can say how many oxidized and other compounds which have not yet been identified.

The crude tar is subjected to distillation in large stills, and is separated into four portions or fractions:

1. The light oil of tar, which is lighter than water.
2. The heavy oil of tar, or "dead oil," which is heavier than water.
3. The green or anthracene oil.
4. The pitch which remains behind in the still.

The light oil of tar consists chiefly of benzol, toluol, etc. It is rectified and sold under the name of coal-tar naphtha, as a solvent for making varnishes, etc. From the residue or "tailings," is prepared the beautiful crystallized carbolic acid, so valuable as a disinfectant, and also as a material for preparing picric acid, the beautiful yellow dye, and the constituent of some of the new explosives. The most recent application of carbolic acid, which is not properly an acid but a phenol, a kind of alcohol, is for the preparation of salicylic acid. This acid exists in oil of wintergreen, which is the acid salicylate of methyl. KOLBE found that this acid could be made from carbolic acid by combining it with caustic soda and exposing the compound to carbonic acid gas at a high temperature. Half the carbolic acid is set free and distils over from the retort in which the operation is conducted, while a compound of salicylic acid with soda remains behind from which hydrochloric acid separates the new acid. Here is a beautiful specimen of the product. It appears as a white, crystalline powder almost colorless and with little taste. If KOLBE's labors had ended with the discovery of this simple method of preparing this acid, you would never have heard of it, but he discovered the wonderful antiseptic properties of salicylic acid, and pointed out a thousand useful applications for it, so that it is now manufactured in large quantities. It is more powerful as an antiseptic than carbolic acid, while its freedom from taste and smell and its harmless character when taken internally give it a far wider range of usefulness. It can be used to prevent the souring of wine, beer, milk, in fact all articles of food. It is extremely useful in checking certain diseases, which appear to depend on the rapid development of minute living organisms, *bacteria*, such as diphtheria, etc. It is probable that we do not yet half realize the valuable purposes which this acid is capable of serving.

Besides the yellow picric acid, several other beautiful dyes are prepared from carbolic acid—for example, phenyl brown or phenicienne, grenarte brown coralline or pacenine, a scarlet dye, and azuline or phenyl blue.

By proper rectification the coal tar naphtha is made to yield nearly pure benzol, or the mixture of benzol and toluol, which is the foundation of the great aniline industry. By subjecting the benzol to the action of nitric acid it is converted into this yellow "oil" or "essence of mirbane," nitrobenzol or, as it is commonly called, artificial oil of bitter almonds. This is very useful as a substitute for the real oil of bitter almonds for perfuming soap, lotions, etc. It is not really artificial oil of bitter almonds although it has the same odor. By subjecting this nitrobenzol to the action of iron turnings and acetic acid, and distilling with caustic soda, we obtain this dark oily liquid which is aniline, a strong base capable of uniting with acids and forming salts. Toluol, another constituent of the coal tar naphtha, yields a similar series of products under like treatment, nitro-toluol, and toluidine, a base which you see is solid, but otherwise similar to aniline.

By subjecting a mixture of aniline and toluidine to the action of agents which remove hydrogen, such as a mixture of arsenic and hydrochloric acids, corrosive sublimate, bichloride of tin, etc., a salt of a new base, rosaniline is produced. This is the primary aniline color. Rosaniline itself is colorless, but its salts are of the most beautiful pink or cherry color in solution, while they appear as crystals with the most beautiful green metallic lustre. As I turn this jar of crystals you can see the brilliant flashes of green and golden light from the faces of the crystals, reminding you of the Brazilian beetles.

By subjecting this aniline red to the action of iodide of methyl, or ethyl, or to the action of aniline itself, it changes to purple, violet, and finally to the most beautiful blue, the operator having it in his power to stop at any desired shade between the red and the full blue. Let me call your attention to these jars, which contain solutions of a dozen or more of these different shades of red, purple, violet, and blue; and to these silks, worsteds, and cottons which have been dyed with them.

You see we have also greens, yellows, oranges, browns, and blacks among our specimens; these are all products of further changes in our aniline, by processes which our time will not permit me to explain. The black is the most intense and permanent that can be produced upon cotton. It is actually made in the fibre by applying the materials to the cotton cloth, and causing them to react and produce the black by exposure to steam.

The heavy oil of tar consists chiefly of hydrocarbon oils, which are not specially interesting. It also contains naphthalene, this beautiful white solid, which is the basis of some beautiful colors, made by processes similar to those used in producing aniline colors. We have this bright Martinus or Manchester yellow, which is a calcium or sodium salt of binitro-naphthalinic acid; this fine Magdala red, which is a distinct base, prepared from naphthylamine by agents which withdraw hydrogen. Then we have these naphthaline blues and violets.

The heavy oil contains carbolic and cresylic acids, and on this account is a valuable source of these antiseptic and disinfecting agents. The oil as a whole is an effective agent for preserving timber from decay, and as a disinfecting agent for sewers, privies, cattle-pens, etc. Thousands of gallons are used every summer in this city by the health department, for disinfecting the privies of the 25,000 tenement houses. Half a gallon of dead oil, costing 4 or 5 cents, and half a gallon of saturated solution of copperas, costing a like sum, diluted with a pail of water, is sufficient for an ordinary privy. The cost of material being not over 10 cents, and the cost for labor, carts, etc., about as much more.

TO BE CONTINUED.

Notes.

The Regents of the State University of California, by a formal vote, have accepted the donation of Mr. LICK of $750,000 for a telescope, and a committee has been appointed to wait on Mr. LICK and return thanks for the Board.

Cost of Lighting New York.—The Gas Commission, consisting of the Mayor, Comptroller, and Commissioner of Public Works, met yesterday, and received the following bids for supplying the City lamps with gas, and lighting the same for four months, from Jan. 1, 1876: New York Gas Company, $9 per lamp; Manhattan Gas Company, $9 per lamp; New York Mutual, $12 per lamp; Metropolitan $14 per lamp; Harlem, $13.75 per lamp. These rates are exclusive of repairs, etc. The proposals for the supply of gas to the public buildings were as follows: New York Gas Company, $2.50 per 1000 feet; Manhattan Gas Company, $2.50 per 1000 feet; New York Mutual Gas Company, $2 75 per 1000 feet; Metropolitan Gas Company, $2 70 per 1000 feet; Harlem Gas Company, $3 per 1000 feet.

Purification of Gas.—The invention of Mr. J. T. LIVESEY, of the South Metropolitan Gasworks, Old Kent road, London, Eng., has reference to apparatus by the employment of which the ammonia and other impurities contained in crude gas may be more effectually removed, and the resulting liquor enhanced in value; and consists in the construction and use of one or more oblong, square, or other suitably shaped but somewhat shallow boxes, chambers, or vessels, each divided by a number of vertical partitions, the lower part of the sides of which are bent or curved so as to recede from each fother, though they may be left vertical, the ends being closed. The curved or lower part of each partition is perforated with a great number of small holes; and between every alternate partition, a horizontal plate, also pierced with fine holes, is fixed to the saidpartitions. It is preferred that two or more of these boxes, chambers, or vessels, technically called "washers," shall be placed side by side at different elevations, so that the liquid supplied to the highest vessel may, by a suitable pipe, flow to the next lower one, and so on. Each vessel being supplied with either water, ammoniacal liquor, or other suitable liquid, the gas is admitted to the lowest vessel, when it descends between the partitions before spoken of, depresses the liquid contained therein, and escapes through the perforations in the sides into the spaces covered by the horizontal plates. The gas then passes through the liquid and the apertures in the horizontal plates, and emerges into the space above, from whence it proceeds, by means of a suitable channel and pipes, to the next vessel above, where the operation is repeated.

American Mines in London.—The recent success of the Eberhardt and Aurora Mines (White Pine District, Nevada) has greatly encouraged English investors in American mines. This company was long in very bad repute, and it was feared would prove like the Emma or Flagstaff, but at the last meeting in London, Dec. 13, it was announced that the profits during the last half year were £43,200, and after paying debts the company had £23,000 to divide. The London *Mining Journal* says: "The shares of Eberhardt and Aurora have been dealt in up to 8⅞, 9, but relapsed upon realizations, notwithstanding the satisfactory character of the information communicated at the general meeting; at this time last year the company was £24,000 in debt; £18,000 was owed in Nevada and £6 000 in this country; so desperate was the financial position of the company that the only two directors left at the board were drawing cheques upon their private banking account to pay ordinary current expenses at the London office; since then all debts have been paid, and for the first half of the year there was a profit of £9,000, and for the last half a profit of £43,200. When the accounts are made up for Dec. 31 there will be a balance of £23,000. A resolution was passed approving the scheme for the immediate redemption of the debentures upon the basis of an exchange of each £10 debenture for one fully paid-up ordinary share at par, with a cash bonus of £2 10/ per share; the shares close 8¼ to 8¾. Richmond Consolidated, 7¼ to 7⅜. Cablegram received: Week's run, $38,000. Connecting new engine. Hoisting suspended part of the week. Resume hoisting on Thursday. The make of bullion for the season is $1,348,000, and since February $1,878,000. The refinery this season has produced gold and silver to the value of $875,000, irrespective of the lead.

Explosions in Coal Mines.

By J. W. THOMAS, F. G. S., of Cardiff, Wales.

THE frightful loss of life which explosions in coal mines are the source of cannot fail to convince us how imperative it is to use every possible effort to prevent their recurrence. It is, however, only necessary to inspect the efficient regulations and system of ventilation which have been carried out, and are now in use throughout the North of England and South Wales coal-fields, to assure one's self that everything is being done to insure the prevention of explosions. It is possible, through the negligence of those whose duty it is to keep the doors (used for dispersing the ventilating currents) closed, that an accumulation of gas may take place in that portion of a mine which derives its air-currents through the medium of such doors. It does not, however, appear probable that explosions, entailing serious loss of life, thus derive their origin, as the miners are fully alive to the dangers accruing, and the slightest negligence in this direction receives its proper censure. It is assumed that miners are very regardless of danger, and that they are sufficiently daring to perforate their lamps with their mandrels, so as to enable them to light their pipes. The more plausible, yet at the same time equally dangerous, practice assigned to them of drawing the flame through the wire gauze for the same purpose, can scarcely be credited.

A miner knows too well when the fire-damp is present in explosive quantity, and it seems too hard to debit him with so heavy a crime as that of deliberately sacrificing his own life, knowing that at the same moment so many of his comrades must inevitably perish. That slight explosions may have happened through such practices there is no doubt, but when such fatal occurrences as that at Barnsley take place, some other cause must be anticipated. The fact that the best ventilated colliery is liable to an explosion has long since been demonstrated and certified to by able mining authorities. When we consider the immense volumes of marsh-gas (fire-damp) which are evolved as blowers even on the surface, an idea may be formed of the danger which would arise when, by working the coal, the source of one of these, or the fissure through which it traversed, was laid open to the gallery or heading of the mine, or by dint of the great pressure, the rock below such a blower suddenly fell. The miners rushing from the spot often leave their lamps behind them, which, from injury or lying on their sides, may, perhaps, fire the explosive mixture. In spite of their energy to escape, the ignited gases, or fatal after-damp, overtake them, and it may thus happen that no one survives from that portion of the mine where the explosion took place. The passage of the flame through an ignited mixture of gases is not instantaneous, and were it possible to observe its movement laterally the eye could easily follow its progress. As soon as the gases are ignited an immense pressure, incidental upon the intense heat, is produced, high pressure steam is generated, and the resulting products are forced onward and onward with increased violence until they meet with more diluted gas, and the flame becomes extinguished. The consequence is that an immense volume of smoke and dust rushes up the pit, and warns the banksmen of the catastrophe. The intense heat generated for the moment soon becomes absorbed in many parts of the mine, and the result is that, owing to the steam becoming condensed to water, the products of combustion, or the after-damp, are gradually lowered in temperature, and a partial vacuum formed; a powerful backward suction of air takes place, and it not unfrequently happens that a second explosion is caused by the back current in the same or another part of a mine. Again, it is possible that two explosions may take place simultaneously through the action of the sound-wave forcing the flame through a lamp in another part of the mine, which may be occupied by gas mixed in explosive proportions. This fact has been ably demonstrated by a gentleman in the North connected with mining.

Until recently it has been generally believed that the after-damp consisted of carbonic acid, water, and nitrogen, together with the oxygen which may not have been consumed, where the proportion of air was insufficient to afford the requisite quantity of oxygen (9.5 parts of air), as much of the fire-damp was consumed and converted into carbonic acid and water as the oxygen present would allow, and that the excess of the fire-damp (marsh-gas) remained in its original condition.

The books at present used by colliery officers contain information similar to the above. This is not, however, the case. The chemical reaction and combination which take place during an explosion are far more complicated than have been hitherto observed. Some eighteen months ago, when experimenting upon the gases inclosed in South Wales coal, I exploded small quantities of marsh-gas (fire-damp) mixed with oxygen in insufficient proportion for complete combustion, and found that carbonic acid and water were not the only products formed, but that, with the smallest volume of air capable of affording combustion, when mixed with fire-damp, little or no carbonic acid and water was formed, the resulting gases consisting of carbonic oxide and free hydrogen. In all cases where the proportion of oxygen is insufficient for complete combustion a large quantity of carbonic oxide is generated. In the event of a strong blower breaking in upon or into a heading, it is only reasonable to suppose that much more of the space traversed by the flame of the ignited gases will be occupied by mixtures containing less than ten volumes of air, and that, in consequence, an immense quantity of carbonic oxide will be generated. In fact, the whole of the carbon of the marsh-gas is converted into carbonic oxide when the oxygen is insufficient to unite with the hydrogen, and thus large volumes of hydrogen are set free. When the fire-damp is mixed with 9.5 parts of air, carbonic acid and water are for the most part formed. It will be readily understood, however, that in every instance of an explosion, mixtures of fire-damp and air will exist in every possible proportion; that is to say, from one part of air with 100 parts of fire-damp to one part of fire-damp with 100 parts of air. The air in the galleries or headings of a coal mine is charged with floating particles of coal dust incidental upon the process of working. These floating particles at the moment of explosion become ignited, and doubtlessly rob the atmosphere of no inconsiderable portion of its oxygen. It will therefore appear evident that, up to the explosive limit of a mixture of air with fire-damp (probably 13 parts), very little oxygen will remain unconsumed. Were it possible for the fire-damp to be present in a mine intimately mixed with about ten times its volume of air, the actual force resulting from the combustion of such a mixture would doubtless be greater than if the fire-damp were present in any other proportion, and the wrecked appearances of devastation in that part of the mine where the explosion happened would also be indicative of vast potential energy. The fact (corroborated by Dr. MEYER, of Germany) that carbonic oxide is present in considerable quantity in after-damp would, I think, naturally lead one to assume that, although more force would be exerted through the combustion of a mixture of ten parts of air with one of marsh-gas, the effects of the after-damp upon those removed from the scene of the explosions would not be so deadly as they manifestly are.

For the purpose of illustration, we will divide the "field of the explosion" into three parts, viz., A, B, and C, where B presents that portion occupied by a mixture of ten parts air and one part fire-damp. A is the portion occupied by a mixture of fire-damp with more than ten parts of air, and C is the portion occupied by a mixture of fire-damp with less than ten parts of air. The intensity of the fire at B will be greater than either at A or C, owing to the heat lost in raising the temperature of the excess of non-combustible gases, and the decrease due to partial combustion. Where B would be the center, as it often is, the effects of the flame upon those to the left of A and the right of B would not be very serious. The unfortunate miners situated at the right, left, and center of B are immediately killed through fire and suffocation. Those at A have also little chance of escape, but those situated to the left of A, through the means of the backward suction, may receive little injury either from the immediate effects of, or owing to, the diffusion of the products of combustion. It not unfrequently happens, perhaps, that there is no outlet to the right of C, and that it is the farthest end of a working, or some new heading into virgin ground. In all instances the victims at C die immediately. Assuming that the proportion of air mixed with the fire-damp decreases from B to C, and that the actual point where the flame of the explosion terminates is known, we have still no idea how far the products of combustion are forced onward by the explosive power. Those miners who are found in the positions which they occupied previous to the explosion, and who exhibit no external signs of injury, are probably found in that portion of the field of explosion situated in advance of where the flame terminated, and to the right of C. Here the largest proportion of carbonic oxide is carried forward, and the miner who receives no warning of the deadly mixture approaching him, either dies instantaneously, or as quickly passes into a painless state of coma, death probably ensuing in less than 10 seconds.

Carbonic oxide is much lighter than carbonic acid; the ratio of their weight is as seven of the former to eleven of the latter, and thus, owing to its lesser density, it will diffuse with greater rapidity, and, through the medium of the induced currents, soon spread over a considerable area of the mine. The fact must not be lost sight of that a portion of the coal taking fire would be the means of vastly increasing the fatal consequences. I have reluctantly quoted a few of the observations, in reference to the presence of carbonic oxide in after-damp, which I have previously published, with a view of bringing them to the notice of mining authorities and the professional gentlemen connected with them, and with the hope that something may be devised which will be the means of saving the lives and alleviating the sufferings of those who have not become absolute victims of the fire or after-damp.

Apart from any desire to raise discussion as to the properties of carbonic acid, I think it is fairly established that a man will live in an atmosphere in which a candle or lamp will burn for some time, and that when the proportion of carbonic acid does not exceed 8 or 10 per cent., he will not suffer any considerable inconvenience therefrom. I am inclined to think that much of the deleterious action of carbonic acid upon the system, when breathed in quantity (say 10 per cent.) is due to the great density of the gas. Carbonic oxide is a violent narcotic poison. When introduced into vital blood in small quantities it is said to absorb the free oxygen, and become converted into carbonic acid, and the deoxidized blood in its passage through the brain exerts a baneful action through its inability to perform the necessary functions, and insensibility results in consequence. May it not form a compound with the hœmaglobin of vital blood similar to that obtained by HOPPE-SEYLER from non-vital blood, and so counteract, impede, or diminish the intermediate functions of hœmaglobin as a bearer (or its combination with) and distributor of oxygen? BERNARD considers that carbonic oxide prevents the arterial blood of the body from becoming venous.

Some time ago, when experimenting upon this gas, I inhaled a quantity of air containing about one-half per cent. of carbonic oxide. A severe headache followed, and to try the efficacy of oxygen as an antidote, I inhaled some which had been prepared beforehand for the purpose. The noxious effects soon abated; I found, however, that oxygen in its undiluted form was too exciting, but after breathing a quantity of air in addition, for a short time, the ill effects ceased. On a subsequent occasion, when preparing a quantity of this gas, I incautiously, though momentarily, inspired some in a somewhat concentrated form. As soon as I became conscious of what had happened, I immediately proceeded to prepare some oxygen, and experienced considerable benefit from its use. These trials have so convinced me of the efficacy of oxygen that I have been led to write this article, influenced by the belief that its artificial appliance may be beneficial to the saving of human life.

The preparation of oxygen has now become a simple operation, and the gases used for oxyhydrogen purposes by very ordinary care can be rendered available. It is scarcely worthy of observation that, should beneficial results follow its application, bags of oxygen would soon find their way to the scene of the explosion. In conclusion, the following analysis of fire-damp may be interesting:

No. 1, from the 6 ft. seam, Aberdare district, 230 yards below the surface.
No. 2, from the 4 ft. seam, Rhondda district, 125 yards below the surface.

	No. 1.	No. 2.
Marsh-gas	95.05	96.74
Carbonic acid	4.26	0.47
Nitrogen	0.69	2.79
	100.00	100.00

—Iron and Coal Trades Review.

Raising the Iron-Clad "Vanguard."—The Lords Commissioners of the Admiralty, having had various plans and proposals submitted to them for raising the *Vanguard*, have resolved on throwing the operation open to public competition, and they are prepared to receive tenders for raising the ship and delivering her in dock. Their lordships have laid down several conditions, the principal of which are that all parties tendering shall furnish satisfactory evidence of their financial ability to undertake the work; that the parties tendering shall undertake to deliver the ship either in a dry dock or at the entrance of one of Her Majesty's docks in such a state that she may be docked, and the delivery is to be considered incomplete till she is safely docked. The ship is to be raised and delivered whole, and not in pieces; no payment is to be made to the contractors, or any claim to payment arise, until the delivery is complete; the contractors are to be responsible for any infringement of patent rights; the time by which the parties tendering propose to begin operations and the probable date of completion are to be stated in the tender; the parties whose tender should be accepted will sign a contract, to be prepared at the Admiralty, binding them to give effect to their tender on these conditions. All tenders are to be for a lump sum, to cover all charges, and not for a percentage on the value of the ship, but their lordships state that they will not bind themselves to accept any tender.

Strains in Truss Bridges.

Written for the ENGINEERING AND MINING JOURNAL.

By JOHN C. TRAUTWINE, Philadelphia.

CAN any of your scientific readers inform me whether or not I am correct in an opinion which I have felt almost compelled to adopt, notwithstanding its apparent absurdity, namely, that neither the principle of the parallelogram of forces, nor that of the lever is applicable to the finding of strains in trusses, *except when said strains are transmitted along members capable of reacting against them with hinged or pinned joints?* As an example with regard to the parallelogram of forces, we will take the simple truss *a b c d*, Fig. 1, consisting of but four members, and load it at *b*, only. Now, we are told by all the authorities that, if we take *b v* to represent the load at *b*, and complete the parallelogram *a b c v*, then *b c* will represent the strain along *b c*, and *b a* that along *b a*. But we know that this is not so, for it throws all the weight of *b* upon the abutment *a*; whereas part of it rests upon *d*. *The joints would yield if pinned.* But place at *c* an additional load equal to that at *b*; or place, half way between *b* and *c*, an only load; or, from *b* to *c*, an equally distributed load, and, in addition, if we choose, place at any points on the rafters, at equal distances from the center of the truss, any other loads equal to each other. In any of these cases the parallelogram of forces will give the strains correctly; and, in all of them, *the joints will be firm if pinned.*

Now take the triangular truss *a b h*, loaded at *b*. Here the parallelogram of forces gives us precisely the same strains, *b a*, *b c*, as before; but this time correctly, for all the weight of *b* will now actually rest on *a*. *All the joints of this truss would resist the strains upon them if pinned.* Still farther on this point, reverting to Fig. 1, suppose a tie inserted from *c* to *a*. The parallelogram will then lead to a correct result, for although it then seems at first to throw all the weight of *b* upon *a*, we shall find as we work out the other strains, that the tie

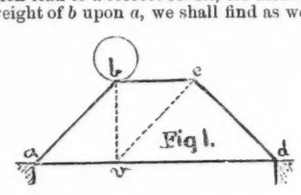

Fig 1.

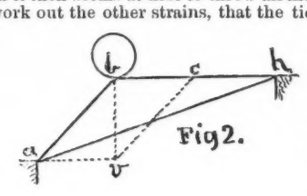

Fig 2.

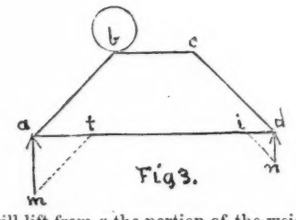

Fig 3.

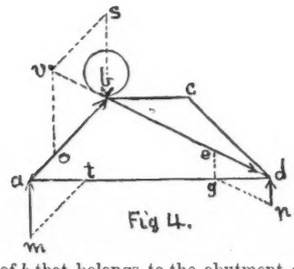

Fig 4.

will lift from *a* the portion of the weight of *b* that belongs to the abutment *d*, and will cause it to be transferred to that abutment. The case has now become one of *counterbracing*, and we cannot tell what is the strain on a member until we find its counter strains. *All the joints in Fig. 1 would now resist the strains upon them if pinned.*

We will now consider the principle of the lever in this same connection, using the truss Fig. 3, which is in all respects the same as Fig. 1, and loaded in the same way. Here the accepted theory is that if we make the vertical lines *m a* and *n d* to represent the respective portions of the load *b*, borne by the two abutments, and draw *m t* and *n i* parallel to *a b* and *c d*, then *t a* and *i d* will represent the horizontal strains on the tie *a d*; while *m t* and *n i* will represent the oblique ones on the rafters *a b* and *c d*. But it is plain that we are here confronted by the palpable absurdity of *two unequal and opposite strains, t a and i d, balancing each other.* The strains along a tie must be equal throughout its length. Therefore the principle of the lever does not here give us the correct strains. *The joints of the truss would yield if pinned.*

Now let the same truss, Fig. 4, be one foot high and three feet long; the *horizontal* distances between *a b*, *b c*, and *c d* each one foot, and the load *b* one ton. Place a strut from *b* to *d*. Then beginning at *a* with the vertical reaction of *m a* or .6667 of a ton, we obtain the same strains as before, namely, *t a*, or .6667 ton, along the tie; and *m t*, or .9427 ton along the rafter *a b*. We will now go to *b* where we have as pushes the two known forces *o b* (.9427 ton) and *s b*; the last being the one ton load at *b*. We find their resultant *v b*, or .7453 ton; and on attempting to resolve it along *b c* and *b d* we see that it is precisely in line with *b d*, which must therefore bear the entire strain of .7453 ton; so that *there is no strain whatever along b c*, and of course none along *c d*. Now we go to *d*, at which we have pushing the two known forces *e d* or .7453 ton, and *n d*, or the upward reaction of .3333 ton of the abutment *d* against the ⅓ of the 1 ton load at *b*. The resultant *g d* of these forces gives us the strain along the tie *a d*; and we find it to be .6666 ton, or the same as *t a*; and not .3333 ton as erroneously given by *i d* in Fig. 3. Therefore in Fig. 4, with the strut *b d*, the principle of the lever gives the strains correctly; and in that Fig. *the joints would not yield if pinned.*

We could not have *commenced* at *d*, Fig. 4, with the principle of the lever, for we should then have had but one known force, *n d*, to be resolved into *three* unknown components along *d a*, *d b*, and *d c*, which cannot be done.

Can any of your readers tell us the actual amounts of the strains on the truss Fig. 4 with the strut *b d* omitted; also the process for finding them?

Now we know that it is very easy to make a truss like Fig. 1 of but four pieces, and by bolts and straps at the joints render it capable of sustaining a heavy load at *b*, without any yielding. It would, therefore, appear at first sight (and probably at many subsequent sights) that this stiffening of the joints would supply such resistances as would balance the strains arising from the load, as indicated by either the parallelogram of forces, or the principle of the lever. But it is not so. No matter how stiff and unyielding the joints of Figs. 1 and 3 may be made, the load at *b* will not produce either the strains *a b*, and *b c*, indicated by the parallelogram of forces, nor those *t a* and *d i* indicated by the principle of the lever. Upon this point I have perfectly satisfied myself by actual experiment.

Now what is the cause of this seeming mystery? Wherein resides the peculiar merit of the joints being, *not actually pinned*, but *merely capable* of being pinned, if we choose to make them in that manner? I must admit that I have not yet been able to answer this question to my own satisfaction.

If the feet of two equal rafters abut against solid rock, and then place a load at the apex where their heads meet, the parallelogram of forces will give the strains produced by the load upon the rafters. *The joints of the arrangement would be firm if pinned.* But if the feet of the rafters abut against the tops of two firmly planted vertical posts, will the parallelogram then give the strains? *The joints would yield if pinned.*

Is not this subject well worthy of the attention and investigation not only of those who are specially engaged in calculating the strains in bridge and roof trusses, but of engineers generally? How shall we be enabled to tell *at a glance* in any case, whether we may, or may not, safely apply the principle of the lever, or of the parallelogram of forces in working out strains from a truss diagram? The mere capability of having the joints pinned is not in itself sufficient, however, in all cases. Take for instance a Warren, or any other simple triangular truss, with all its joints actually pinned, and load it on one side only. Neither the parallelogram of forces, nor the principle of the lever will then serve for working out the strains from a diagram.

JOHN C. TRAUTWINE.

PHILADELPHIA, Dec. 29, 1875.

Coal Gas as a Fuel.

RECENTLY, a lecture was delivered, at Manchester, England, before the members of the Society for the Promotion of Scientific Industry, by Mr. JOHN WALLACE, on "The Combustion of Coal Gas and the Theory of the Structure of Flames," and during the course of his remarks the lecturer said that gas was the perfection of fuel. It could be produced from materials unfit for burning in small fires or furnaces; it could be lighted in a moment, and burnt with the utmost regularity. There were certainly many methods of using coal for heating purposes which were more economical than gas, but most of them were expensive to apply, and none of them possessed all the advantages of gas fuel. With regard to the use of gas for furnaces and steam purposes, the lecturer explained and exhibited a gas furnace consisting of 12 burners, each 1 in. in diameter, fixed on a flat cast-iron box, which supplied them all with gas. This furnace had been taken from below a steam boiler used for driving three printing machines at a cost of ½d. per hour for gas. The products of consumption, after passing upwards through the tubes to the boiler, were carried by a jacket down the outside and escaped by a flue at the base of the boiler, thus making the whole surface available for heating This arrangement made a damper unnecessary, as the speed of the draught was due to the difference of the temperature of the hot gases ascending in the tubes and those descending in the jacket. Since this furnace was used, the tubes had never required sweeping, which was a most satisfactory testimony to the completeness of the combustion. Previously, when another furnace was used, which depended on the chimney draught, the whole heating surface had to be swept at regular intervals. Among other useful applications of the heating burner, the gas-stove was one of the most important. It was to be found wherever gas was used, and in spite of many real or imaginary objections, it was steadily making its way in public favor. It was a great pity, he added, that gas companies who had brought the construction of the gas-meter to such perfection should have allowed the manufacture of gas-heating apparatus to fall into the hands of the most ignoront class of manufacturers, who were to blame for nearly all the bad repute attached to the system. Gas companies, however, were by degrees taking the matter in hand, because they found that it provided duty for their mains in the day-time, but the mischief was already done, which it would take years to undo. A discussion followed the reading of the paper, during the course o which the Chairman (Mr. BELLHOUSE) expressed the opinion that gas companies should take into consideration the application of gas to heating purposes, and he was sanguine enough to believe that in a short time many of our large steam engines would be worked with gas. He had witnessed many ineffectual experiments with oil, but he thought gas in heating boilers could be applied with great success.

CORRESPONDENCE.

The Burns and Harvey Gas Wells, Near Pittsburgh, Pa.

TO THE EDITOR—SIR: In the ENGINEERING AND MINING JOURNAL (October 30, 1875), a letter of Prof. WUTH is published, in which the estimated flow of the BURNS well is given at 1,000,000 cubic feet per hour, or 24,000,000 cubic feet per day.

According to Prof. WORMLEY'S analyses, twenty specimens of Ohio bituminous coal yield, on distillation, a little less than three cubic feet of gas per lb. At this rate it would require 4,000 tons of bituminous coal to produce gas equal to the daily flow of this well. This is about the yield of one acre of a three-foot coal. These figures are so very large and so much in excess of the estimated yield of Ohio gas wells, that it seems to me there is certainly some mistake in the Professor's figures.

In the paper in which Prof. WUTH'S letter is quoted, it is stated that the pressure of the gas in a 5⅝-inch pipe in the HARVEY well was 110 lb., while it is given as 130 in a pipe of the same dimensions at the BURNS well. Of course the HARVEY well will yield the largest flow of gas. It appears, also, that a six-inch pipe, laid from the HARVEY well to Etna Spring, CHALFANT & Co.'s mill, was filled in thirty-six minutes after the gas was turned on at the well, and that this mill is either 18⅛, or 16⅛ miles from the well. Calling the distance eighteen miles, the capacity of the six-inch pipe is substantially 18,057 cubic feet. As it took thirty-six minutes to fill this pipe, the actual flow of gas was 501¼ cubic feet per minute, or 30,060 cubic feet per hour, making the daily flow 721,440 cubic feet, while the Professor's estimate of a well of less capacity is 24,000,000 cubic feet.

The flow, as indicated by the time it took to fill the six-inch pipe, differs but little from the estimated flow from a well in Coshocton County, Ohio, where the gas, in a *closed* pipe, quickly carried the index of a steam-gauge to 180 lb. per inch, being the maximum pressure the gauge would work. The gas from this well is now successfully used for the manufacture of carbon black of great excellence.

Natural gas can be obtained over wide areas and beyond the limits of the coal fields, and is unquestionably to become a very important element in our manufacturing industries. It is very important that the quantity likely to be obtained from the best wells should not be over-estimated. M. C. R.

HUDSON, Ohio.

The report of Prof. WUTH, referred to, contains several statements that are, at

least, open to discussion. The specific gravity, for example, is given as 1.56, which is evidently an error, as are also the calculations based on it. The specific gravity of the gas is probably not more than half this amount. The calculation by which the Professor shows that the gas will have a pressure of fifty pounds per square inch at Pittsburgh, is also erroneous, as in reality the pressure is less than *one pound*. Our correspondent seems, however, to have made no allowance for friction in the pipe; as this increases, as the square of the velocity and directly as the area of the rubbing surface it is evident that the whole motive power would very soon be absorbed in overcoming the friction. And, indeed, this seems to have been very nearly the case in practise. A certain amount of gas is obtained in Pittsburgh but with an exceedingly low pressure. The remedy is to be found in *larger pipes*.—ED. E. & M. J.

Notes.

Wolfram Steel.—Tin to the amount of 1.26 per cent. has been found, as well as wolfram and manganese, in the so-called special steel. This is accounted for by the fact that in the making of this steel neither wolfram nor pure wolframic acid is made use of, but woltram ore with an admixture of impurities of oxide of tin. Herein possibly lies the explanation of the variety of opinions, in reference to the qualities of wolfram steel, and the variety of products springing from the employment of wolfram ore; and it can also be deduced that more constant results could be obtained by the use of wolfram metal or the alloy of wolfram with iron. Wolfram steel has lately begun to be taken into use for telegraph work, since, in consequence of its superior hardness, a magnet of more permanency is obtained than with ordinary steel.

Metallic Gallium.—This body has at last been obtained in a metallic form. On December 6th M. WURTZ submitted a specimen of it to the Academy of Sciences. It is a beautiful metal, taking rank for lustre between platinum and silver. It was obtained by electrolysis of the aqueous solution of its ammoniacal sulphate, the precipitate being submitted to the burnisher. M. LECOQ, the discoverer of the new element, has been pursuing his investigations, and finds that it dissolves in hydrochloric acid with disengagement of hydrogen, feebly in the cold and more easily when aided by heat. Gallium having strong affinities with zinc the separation of the two metals is not at all easy. To effect it, M. LECOQ treats the solution of the two metals with carbonate of soda, which precipitates all the gallium and only a little zinc. The precipitate is redissolved in sulphuric acid, and neutralized by an excess of ammonia. Acetic acid being added the whole is boiled. The oxide of gallium is precipitated, behaving in this like the oxide of aluminium. As another analogy with aluminium may be noted the combination of the sulphate of gallium with alkaline sulphates, giving origin to an alum, which crystallizes in cubes.

Electro-Deposition on Glass and Porcelain.—The decoration of porcelain has, for some time past, been effected in France by depositing copper, in any pattern, on an enameled surface, to a sufficient depth to admit of engraving or chasing. In the objects noticed, the metallic deposits were firmly fixed to the glass, and had been gilt. The process is said to be as follows: The enamel is prepared in the usual way, the places reserved, as the basis of the deposited pattern, are gilt with good gold, and the whole burnt. In the bath, deposition takes place on the parts gilt. When copper has been deposited to a thickness equal to that of the enamel, the object is superficially gilt. The thickness of the layer of copper will vary from 1 to 3 millimeters. Experiments were made with a DANIELL'S battery, and the following baths: Copper, 2 parts by weight of the sulphate in 5 of water. Silver: 17 parts nitrate of silver dissolved in 170 of water; 13 cyanide of potassium in 130 of water. The two solutions are mixed together. The cheesy precipitate first formed has to be entirely dissolved. Gold: (1) 7 parts gold dissolved in aqua regia, thrown down with an excess of ammonia, the precipitate decanted, filtered, and before becoming dry, put in a hot solution of 9 parts cyanide of potassium in 30 water. The solution is diluted with 60 parts water. (2) 10 parts of the preceding bath are mixed with 1 of the silver bath, and left unfiltered, to produce green-gold.—*Iron*.

SELECTED LIST OF PATENTS.

FOR THE WEEK ENDING DEC. 25, 1875.

RELATING TO MINING, METALLURGY, GAS MAKING, ENGINEERING, &C. REPORTED FOR THE "ENGINEERING AND MINING JOURNAL" BY LOUIS BAGGER & CO., SOLICITORS OF PATENTS, WASHINGTON, D. C.

170,760. Distilling Zinc from its Ores, G. E. Moore, Jersey City, N. J.—This improvement in the art of distilling metallic zinc from its manganiferous ores, consists of the treatment of the manganiferous zinc ores, supplementary saturating material, and carbonaceous matter simultaneously in the distilling vessel, by heat.

171,189. Ore-Jiggers, Abraham Stroh, Mauch Chunk, Pa.—The pan is terraced and perforated at the side and bottom. A valve controls annulus between side and bottom, and is vertically adjustable relatively to pan. A coiled spring assists in lifting jigging-pan. The coal passes over edge of pan, the slate down through annulus. Water rising through perforations, when pan goes down washes the slate off the terraces. Carriers convey the separated material to chutes.

171,183. Manufacture of Steel, Frederick J. Slade, Trenton, N. J.—The amount of carbon, chromium, titanium, or other steelifier, is regulated by addition, or subtraction, to the amount required to sufficiently supplement the action of the phosphorus and produce the desired quality of steel. The inventor claims: the process of forming steel by regulating in an alloy of iron, manganese, and phosphorus, the quantity of carbon, silicon, chromium, or titanium to supplement the steelifying action of the phosphorus already in the steel, to the desired extent.

171,102. Extension Caps for Piles, Jno. C. Davis, Baltimore, Md.—An extension cap for repairing partially decayed piles, is constructed of metal in two parts, to be clamped and firmly secured to the top of the piles where the wood is sound after the top has been sawed off below the point of decay.

171,084. Manufacture of Iron and Steel, E. A. Jones, Middlesborough, England.—These improvements in the manufacture of iron or steel, consist in first effecting the partial reduction or removal of the carbon, silicon, and phosphorus, or a portion of any one of them, contained in the pig iron or metal in a cupola or other furnace, by the means set forth, and then effecting a further reduction or removal of a further portion of the carbon, silicon, and phosphorus contained in such metal in a rotary or mechanical furnace, the iron or metal from such cupola or other furnace being charged in a molten state into the rotary or other furnace where puddling is effected by mechanical means, in such manner that iron or steel may be obtained.

171,117. Manufacture of Gas, Joseph P. Gill, Newark, N. J.—Hydrogen is manufactured continuously by passing steam over heated iron, which is deoxidized by small quantities of hydrocarbon. The hydrogen enters an empty still or vaporizing chamber, into which hydrocarbon enters simultaneously in regulated quantities. Resultant vapors pass into an expansion-chamber, thence to retorts receiving on the way, if desired, an additional quantity of super-heated steam and hydrocarbon either, or both. From the retorts the gas may be taken to holders for use, or may be taken to mains, where it is mixed hot with ordinary hot coal-gas, passing in either case through the usual purifying apparatus and processes.

171,130. Electric Gas-Lighting Apparatus, C. H. Hinds, N. Y.—When gas is turned on and lighted at the burner, a small jet is lighted; this, as a lighter, is then automatically carried around, lighting the remaining jets, the supply to the lighter being cut off as it completes the round.

171,162. Gas Furnaces, Alex. Parkes, Gravelly Hill, Erdington, England.—The carbonic oxide resulting from the smoldering combustion of the charges in the generators, and the heated air circulating through the passages in the furnace-sides, discharge into a common fire-chamber in front of, and opening into, the metallurgic furnace proper, wherein their combustion is perfected.

STATISTICS OF COAL PRODUCTION.

The receipts at Port Richmond for the week were 1,000 tons, shipments 5,000 tons, and balance on hand 156,500 tons.

The decrease of shipments of Cumberland Coal over the Cumberland Branch and Cumberland and Pennsylvania Railroads amounts to 54,959 tons.

The Receipts at Perth Amboy for the week were 9,310 tons, shipments 3,000 tons, and balance on hand 83,463 tons.

The Exports of Coal from Baltimore for the week were 865 tons, and for the year, 38,460 tons as compared with 70,765 tons to the corresponding time in 1874.

Receipts of Coal at Boston, for week ending Dec. 31, and years from September 1st, 1874 and 1875.

From	Week. Tons.	Previously. 1875. Tons.	1874. Tons.
Alexandria and Georgetown	1,016	49,886	45,700
Philadelphia	5,919	315,783	234,202
Baltimore	2,685	56,700	60,864
Other places	2,100	123,987	96,792
Great Britain	—	704	1,733
Nova Scotia	748	11,868	14,105

Shipments from Pictou, N. S., for the week ending Dec. 4:

	Tons. Week.	Year.
To United States	—	28,121
" West Indies	—	3,971
" South America	—	4,772
" Canada	—	140,878
" Other Provinces	1,300	67,714
	1,300	245,456

Belvidere Delaware RR. report to Dec. 31:

	Week.	Year 1875.	Year 1874.
Receipts of coal at Coal Port (Trenton)	—	188,712	259,742
" " " South Amboy	13,319	318,724	639,761
Shipments of Coal Port (Trenton)	—	195,361	267,854
" South Amboy	5,820	335,248	620,562

Shipments from Block House, Cow Bay, C. B. to the following destinations, from Dec. 1 to 17, 1875:

	Week.	Year.
Provinces	358	8,132
West Indies	940	2,333
United States	—	11,039
	1,298	21,504

COAL TRADE REVIEW.

NEW YORK, Friday Evening, Jan. 7, 1876.

Anthracite.

The mild weather which prevailed for about two weeks reduced the retail trade very much, so that the inquiries of dealers have been very small until within a day or two past, when colder weather set in. The demand from other classes of trade has been so small that all the business done and doing in anthracite coal is hardly worthy of notice. Prices continue very irregular, and for ordinary qualities of coal it does not seem possible that any business can be done at circular rates, although some claim that there is. Pittston coal is openly quoted as follows: Per ton, f. o. b. Weehawken, Lump, $4 75; Steamer, $4 75; Grate, $4 90; Egg, $5; Stove, $5 65; Chestnut, $4 85. These prices are being shaded according to buyers, while other coals are offering in great abundance fully as low, and in many cases very much lower.

The Combination Committee on rules for the regulation of the business of 1876 has not yet reported, although it is said to have had numerous sessions. Until buyers are satisfied of an amicable settlement of a basis of operation for this year, there is but little business likely to be done. Owing to the necessary labor involved in the careful revision of the returns of the production of Anthracite coal, for 1875, we shall not be able to publish them for a little while yet

We note a rumor of a large sale of Pea coal to be delivered on the Hudson River, within 90 days, at $3 a ton.

Bituminous.

The Cumberland trade continues very quiet, although favored with weather that has left open shipping ports. The Clearfield trade is also dull, although we have been informed of some business in a large way.

A number of representatives of Cumberland companies met in this city on Wednesday, to consider a reduction of miners' wages. The Consolidation Coal Company was the only company not represented by an officer empowered to act. It was resolved that a reduction be made on the 1st of February, provided producers representing 90 per cent. of the total output will join in the movement. The views of the Consolidation Coal Company are not known, but it is thought that if it become a party to the movement, that there will be no difficulty in securing the desired 90 per cent. representation; and in case it does not, there should be a sufficient power to make the movement a success without it.

The total shipments over the Cumberland and Pennsylvania Railroad and the Cumberland Branch Railroad during 1875, were 2,159,880 tons, as against 2,214,839 tons in 1874, showing a loss, last year, of 54,959 tons. The deliveries to the Baltimore and Ohio Railroad show a falling off of 260,692 tons, while those to the Chesapeake and Ohio Canal show a gain of 112,737 tons. and to the Pennsylvania Railroad a gain of 92,996 tons. The latter, added to the gain in semi-bituminous coal tonnage from Central Pennsylvania, makes a very handsome exhibit for the Pennsylvania Railroad.

Foreign and Gas Coals, as is customary at this season of the year, are very quiet.

Wholesale Prices of Anthracite Coal for Jan. f.o.b. at the Tide Water Shipping Ports per ton of 2240 lb.

	Lump.	Steamer.	Grate.	Egg.	Stove.	Chestnut.
Wyoming Coals.						
*Lackawanna and Scranton at Hoboken	5 05	5 15	5 25	5 65	6 10	4 95
¶Pittston at Wehawken	5 05	5 15	5 25	5 65	6 10	4 95
Wilkesbarre at Port Johnston	5 05	5 15	5 25	5 65	6 10	4 95
Plymouth, R. A., *Net*	....	....	5 25	5 65	6 10	4 95
Susque. Coal Co. at Amboy W.A.	5 05	5 15	5 25	5 65	6 10	4 95
Kingston at Hoboken	5 05	5 15	5 25	5 65	6 10	4 95
Lehigh Coals.						
Old Company at Port Johnston	5 55	....	5 55	5 65	6 10	5 10
Old Company's Room Run "	5 55	....	5 55	5 65	6 10	5 10
§Sugar Loaf, Hobok. &Amb."	5 55	....	5 55	5 65	6 10	5 10
Lehigh Coal Exchange "	5 55	....	5 55	5 65	6 10	5 10
Honey Brook Lehigh	5 55	....	5 55	5 65	6 10	5 10
Spring Mt. C. Co. at Hoboken	....	....	....	....	....	....
Beaver Meadow at South Amboy	5 55	....	5 55	5 65	6 10	5 10
†**Schuylkill Coals at Port Richmond.**						
Schuylkill white ash	4 55	4 65	4 75	5 15	5 60	4 45
Schuylkill red ash	....	....	5 05	5 25	5 65	4 45
Shamokin white and red ash	....	....	....	5 40	5 80	4 50
Lorberry	....	....	5 90	5 90	5 90	4 65
Lykens Valley	....	....	6 50	6 50	6 50	5 50

Per ton.

Freight from Hoboken and Weehawken to New York .... 40c.
" " Elizabethport & Port Johnston to N. York. 45c.
" " South Amboy to New York .... 50c.

*Freight on Lackawanna coal from Rondout to New York, by boats or barges of the D. and H. Canal Co. 50c. per ton, the expense of towing vessels from New York harbor to Rondout and back will be borne by the Company.

†Freight from Port Richmond to New York (free of discharging) 85c. per ton.

‡Prices to the Trade.

§By Canal at New York, Jersey City and Brooklyn, 30c additional alongside.

Schuylkill coal is delivered f.o.b. of boats in New York harbor at 50c. per ton additional to these rates.

¶These rates are nominal.

Wholesale Prices of Bituminous Coal.

Domestic Gas Coals.

Per ton of 2240 lb.	At the Shipping Ports.	Alongside in New York.
Westmoreland and Penn. at Greenwich, Philadelphia	$5 20	$6 50
" " at S. Amboy	6 00	6 50
Red Bank Cannel Pa. at Philadelphia	8 00	8 50
" " South Amboy	8 50	.. .
" Orrel	6 00	6 50
Youghiogheny, Waverly Co., at Balt	5 00	6 50
Despard, West Va.,	5 00	6 50
Murphy Run, West Va., at Baltimore	4 75	6 50
Fairmount, West Va,, " "	4 75	6 50
Newburgh Orrel, Md. " "	4 75	6 50
Cannelton Cannel, W. Va., at Richmond.	9 50	11 00
" Splint, " "	5 00	6 50
Peytona Cannel, " "	9 50	11 00
Straitsville " at Sandusky, O	3 25	10 00

Foreign Gas Coals.

	Sterling.	Am. cur'cy.
Newcastle, at Newcastle-on-Tyne	10/6@12/9	6 50@7 00
Liverpool House Orrel, at Liverpool	26/	13 00
Ince Hall Cannel "	47/ 18 0	@20 00
" Gas Cannel "	32/ 6d	13@14
Scotch Gas Cannel, at Glasgow, nominal,	25/	7 50
	Gold.	
Block House, at Cow Bay, N. S	2 00	5 50
Caledonia, at Port Caledonia	1 75	5 25
Glace Bay, at Glace Bay	1 00	5 50
Lingan, at Lingan Bay	1 75	....
Sydney, International and Reserve mines, at Sydney	2 00	5 50
Pictor, Albion & Vale mines, at Pictou.	2 25	5 75

Steam and House Coals.

Broad Top, at the mine, $1 25; at Amboy	4 75@5 00	5 25@5 50
Cumberland, at Georgetown and Alexandria, Va	4 00@4 25	5 25@5 50
Cumberland, at Baltimore	4 25@4 35	5 75@6 00
Clearfield and Allegheny, "Kittanning," "Sterling," "Souman," and "Eureka," at the mines, 90; at Greenwich, Phil.	4 25	5 65

Retail Prices in New York.

Anthracite.

Per 2000 lb.	Grate and Egg.	Stove.	Chestnut.
Pittston coal, in yard	$5 70	$6 00	$5 30
Lackawanna coal, delivered	6 75	7 00	6 25
Wilkes-Barre, "	7 00	7 25	6 50
Lehigh & Locust Mountain, del'd	7 25	7 50	6 75
Schuylkill Red Ash, del'd	7 50@	8 00	

The Cost of delivering Pittston coal ranges from 40 cts. to per ton, according to distance from the yard.

Williamsburgh, N. Y.

Lackawanna Coal delivered.

Stove	$7 00
Egg	6 50
Chestnut	6 00

Egg and chestnut, sizes of the Old Company's Lehigh coal is 25c. per ton more than the above rates.

Bituminous.

Liverpool House Orrel, delivered, per ton of 2000 lb	$23 00
Liverpool House Cannel " " "	25 00
American " " " "	15 00
Kanawha splint, " " "	15 00
American Orrel " " "	11@14
Red Bank Cannel " " "	14 00
Cumberland " " "	9 00

Baltimore, Md. Jan. 4, 1876.

Reported by our Special Correspondent.

ANTHRACITE.

Wholesale or Trade Prices per 2240 lb.

Wilkes-Barre "Lee" or "Diamond," *Pittston and Plymouth,* White ash.	In cars at depot.	By boats afloat.
Lump and steamboat	$4 80	$4 65
Broken	5 55	5 40
Egg	5 92	5 77
Stove	6 17	6 02
Nut	4 97	5 10
Shamokin, (red or white ash), and "Boston," freeburning white ash,		
Egg	5 95	5 79
Stove	6 15	5 99
Lykens Valley, red ash,		
All sizes	6 55	6 37

From wharf or yard, wholesale, 50@75c. additional.
By retail, all kinds and sizes, per 2240 lb. $7 00@8 00.

BITUMINOUS.

George's Creek and Cumberland f. o. b. at Locust Point	4 15	4 50
West Virginia f. o. b. at Locust Point		5 50
Youghiogheny Gas, f. o. b. at Locust Point		5 50
Swanton Coal, George's Creek		4 40

Boston. Jan. 4, 1876.

Reported by our Special Correspondent.

CARGO PRICES TO TRADE.

Lingan coal	$ 5 20	Westmoreland and Penn.	6 85
Caledonia	5 00	Waverly Co. Youghiogh'y.	6 80
Pictou	5 60	Cannelton Cannel	11 60
Block House	5 20	Cumberland	5 80@ 6 00
Red Bank Cannel	9 00	Anthracite .6 50@	7 25
Glace Bay	5 00	" retail..7 50@	8 00
Sydney	6 25		

Buffalo, N. Y. Jan. 3, 1876.

Reported by our Special Correspondent.

ANTHRACITE.

	Afloat. f.o.b.	Retail, Deliv'd.
Grate	$6 40	$7 40
Egg	6 40	7 40
Stove	6 85	7 85
Nut	6 60	7 60

	Lump.	Run of Mine.	Nut.	Slack.	Nut & Slack.
Connellsville Coke	$5 25	....	....	....	....
Brookfield Coal	....	....	....	....	....
Briar Hill	4 50	....	....	....	3 00
Youghiogheny	4 5	....	....	....	....
Monterey	3 75	3 50	3 25	2 50	....
Catfish	3 75	3 50	3 25	2 50	....
Stoneboro	....	....	3 25	2 50	....
Sterling Cannel	5 50	....	....	....	....
Buffalo Coal Co	3 50	3 25	....	2 30	....
Cameron	....	3 25	....	....	....

Chicago, Ill. Jan. 5, 1876.

Specially reported by Messrs. RENO & LITTLE, Coal Merchants.

Retail prices per ton of 2000 lb. delivered to buyer.

No change in prices of coal.

		BITUMINOUS.	
Lehigh Lump	$10 50	Briar Hill and Erie	@ 7 00
Lehigh grate and egg	10 50	Walnut Hill, Pa	@ 6 50
Lehigh stove and chest	11 00	Midway, Pa	@ 6 50
Lackawanna, Wilkes Barre and Pittston*		Cannel	@ 8 00
Grate and egg	9 50	Blossburg	7 50
Stove and chestnut	10 00	Indiana Block	6 00
		Hocking "Brooks"	6 50
		Wilmington and Illinois.	5 00

* 50 cents off these prices for car load lots to country dealers and manufacturers.

Cincinnati, O. Jan. 3, 1876.

Reported by our Special Correspondents.

Owing to the late runs of coal from Pittsburgh, the prices of all kinds of soft coal have declined. The following are the quotations:

Per ton of 2200 lb.	Bush.	Ton.
Youghiogheny, or Pittsburgh, afloat	9 c.	——
Pomeroy coal	6 c.	——
Kanawha "	10 c.	——
Cannel coal, according to quality	16 c.	——
Semi-Cannel	7½c.	——

The following are the retail prices delivered

Youghiogheny	—c.	$3 50
Semi-Cannel	—c.	3 50
Pomeroy	11c.	2 75
Cannel	—c.	6 00
Kanawha Semi-Cannel	13c.	3 60
Anthracite	10 00@11 00	
Foundry coke	10c.	——
Coke, hard and soft	10c.	....

Cleveland, O. Jan. 4, 1876.

Specially reported by Messrs. WARNER, BATES & CO.

WHOLESALE.

Per ton of 2000 lb. f. o. b. vessels.

	For vessels,	On cars.
Youghiogheny Gas Coal	$4 40	$4 15
Cannel	4 50	4 15
Blossburgh	5 00	5 00
Briar Hill Block Coal	3 80	3 60
Hocking Valley	3 25	3 10
Straitsville Coal Co, lower vein	3 25	3 10
Massillon	3 10	3 30
Tuscarawas Valley	2 85	2 70
Columbiana	2 80	2 60

RETAIL DELIVERED.

	Lump.	Nut.
Briar Hill	$5 00	$3 50
Massillon	4 50	4 00
Mineral Ridge	4 50	4 00
Columbiana	3 25	3 00
Straitsville Coal Co., lower vein,	4 00	3 00
Tuscarawas Valley	3 25	3 00

ANTHRACITE DELIVERED.

	Grate.	Egg.	Stove.	Chestnut.
Lehigh	$9 00	$9 00	$9 50	$9 25
Wilkes-Barre	8 10	8 10	8 50	8 25
Lackawanna	8 10	8 10	8 50	8 25

Detroit, Mich. Jan. 4, 1876.

Specially reported by Messrs. ROBINSON & KEYS, Dealers in all kinds of coal.

Per ton of 2000 lb.

Lehigh Lump, per ton	$10 50	Blossburg	8 50
Lehigh " prep.sizes.	10 00	Briar Hill	7 50
Wilkes-Barre, Grate and Egg	9 00	Willow Bank	7 00
Wilkes-Barre, Stove and Nut	9 50	Erie	5c
		Massillon	7 00

Erie, Pa. Jan. 4, 1876.

Reported by our Special Correspondent.

Wholesale, per ton of 2000 lb.	Bituminous f. o. b.		
Briar Hill lump	$3 75	Beaver lump	$3 50
Midway	3 25	Cat Fish	3 00

Indianapolis, Ind. Jan. 4, 1876.

Specially reported by Messrs. COBB & BRANHAM

We quote coal in our market as follows:

Wholesale on board cars, and retail delivered to consumers.

Per ton of 2000 lb., bushel of 70 lb.

BITUMINOUS.

IndianCreek, per ton	$2 75	Peytona cannel, per ton.	7 00
White River, "	2 75	Indiana Cannel	6 50
Brazil Block, "	2 90	Hocking Valley	4 25
Highland, grate, "	2 50	Youghiogheny	4 75
Block coal, nut, per car	18 00	Blossburg (smithing)	6 50
Highland " "	18 00	Piedmont "	6 50
Block Slack "	17 00	Gas coke, per bushel	10

ANTHRACITE (Lackawanna and Wilkes-Barre.)

Broken	$8 70	Nut	8 75
Egg	8 70	Stove	9 00

Lehigh Anthracite.

Broken	10 35	Nut	10 35
Egg	10 35	Stove	10 60

Retail, per bushel, delivered.

Sand Creek	16c.	Block Nut, steam	9
White River	14	" Slack, "	8
Brazil Block	15	Peytona Cannel	28
Highland grate	13	Virginia "	27
Block Nut, domestic use.	12	Youghiogheny	22
Highland Nut, "	12	Blossburg	26
" " steam	9	Piedmont	26

GAS COKE (measured.)

Crushed	15c.	Lump	12c.

ANTHRACITE.

Wilkes-Barre and Lackawanna (all sizes) $9 75 per ton.
Lehigh, retail $11 50 per ton,

Louisville, Ky. Jan. 4, 1876.

Specially reported by Messrs. BYRNE & SPEED.

WHOLESALE.

per bushel		per bushel	
Pittsburgh	10c.	Pine Hill	—
Raymond City	9c.	Kentucky	—

RETAIL.

per bushel		per bushel	
Pittsburgh	14c.	Peytona Cannel	20@22c.
Raymond City	13c.	Buckeye "	
Pine Hill	13c.	City-made Coke	11c.
Kentucky	12c.	Anth., per ton,	$10 00 to 10 50

Screened Pittsburgh per load	$3 00
Screened Raymond City	2 75
Pine Hill (Kentucky)	2 75
Cannel	$5 to 5 50

Milwaukee, Wis. Jan. 4, 1876.

Specially reported by Messrs. R. P. ELMORE & CO.

Retail price per ton of 2000 lb.

Lehigh Lump	$10 00	Briar Hill, select	$8
Lehigh Prepared	11 00	Blossburgh	8
Lackawanna (all sizes)	10 00	Cannel	8
Pittston	10 00	Pittsburgh	7
Scranton	10 00	Steam coal	7

New Orleans, La. Jan. 4, 1876.

Specially reported by Messrs. P. & R. DE VERGES, Wholesale and Retail Dealers in Pittsburgh, Anthracite, Cannel and other Coals.

Pittsburgh coal, retail, per bbl	6.c.
" wholesale	35c.
" steamboats, per box	50c.
" to manufacturers, per bbl	55c.
" shipments, per hhd	$6 00
Anthracite, wholesale, per ton	9 50
" retail, "	12 50
Virginia Cannel, per bbl	8.c.
Scotch " "	....
Mt. Carbon, wholesale, per bbl	...
" " retail, "	....
St. Bernard, wholesale, per bbl	....
" retail, "	....

Pittsburgh, Pa. Jan. 5, 1876.

COAL.—The coal trade continues dull, although the stock in first hands has not been so much reduced for several years, owing to an almost uninterrupted navigation for a couple of months. Some of the diggers are still out on a strike, while others who were out have gone in. Those operators who ship by river are in good shape for a strike.

COKE.—Trade continues dull, as it generally is at this particular time, and the prospects for an early improvement are not very encouraging, in consequence of the continued depression in pig iron. Prices are weak, but without quotable change; 5c. per bushel, or $2 50 per ton, delivered free on cars in Pittsburgh. Freights have been advanced recently on the Pittsburgh and Connellsville road, which is now under the immediate control of the Baltimore and Ohio Railroad, and there is a bitter complaint in consequence.—*American Manufacturer.*

Richmond, Va. Jan. 4, 1876

Specially reported by S. H. HAWES, Dealer in Coal.

Per ton of 2240 lb., f.o.b.

Kanawha Cannel	$12 00	New River Bituminous,	$4 50
" semi-Cannel	4 75	Clover Hill Coal	4 25
Coalburgh Splint	4 75	James River Bitum	3 30
Lewiston "	4 75	" " Carbonite,	5 80
Kanawha Gas coal	4 50		

San Francisco, Cal.

From the *Commercial Herald*, Dec. 23, 1875.

Imports from January 1st to Nov. 30:

Anthracite tons	12,286	English, tons	45,637
Australian, tons	125,133	Vancouver Island, tons	55,407
Coos Bay, tons	29,937	Rocky Mountain, tons	53
Cumberland, tons	10,228	Seattle, tons	57,511
Mt. Diablo, tons (11 mos)	131,587	Bellingham Bay, tons	10,945

The receipts during the week embrace a fleet of small colliers from Coos Bay, thus feeding the market with this desirable house coal. Seattle is crowding shipments: arrivals this week embrace the cargo per *Commodore*, 1,600 tons; *Victor*, 925 tons; *Aureola*, 1,200 tons. The British Columbia mines are yielding largely; from Departure Bay we have the *Washington Libby*, with 1,500 tons; *Grace Darling*, 1,425 tons. There is a lull in the Australian supply, and some little improvement may naturally be looked for from any cargoes that may reach us within the next thirty days. In the interim our supply of Anthracite, Lehigh, and Cumberland is more liberal than for a long time past, causing prices to favor the buyer. We quote Sydney cargoes at $8 75@9; Wallsend, $9@9 25; Cumberland in bulk, $14@15; casks, $16@18; Bellingham Bay, at $8 50; Coos Bay, $10; California Mt. Diablo Steam, $6 25@8 25 for fine and coarse respectively; English and Scotch Steam, $9@10; Nanaimo, $9 50@10; Seattle, $9 25@10; Anthracite, $15@16; Lehigh $18@20. The arrivals include the following; *Henry Buck*, from Nanaimo, with 910 tons; *Revere*, from Departure Bay, with 1,130 tons; and the *Harrison*, from Seattle, with 500 tons.

Toledo, Ohio. Jan. 4, 1876.

Specially reported by Messrs. GOSLINE & BARBOUR.

Per ton of 2000 lb. on cars.

Hocking Valley	$3 40	Massillon	4 00
Straitsville	3 40	Youghiogheny	5 00
Shawnee	3 40	Blossburg	7 00@7 50
" nut	2 90	Cumberland	7 00@7 50
Briar Hill	5 50	Connellsville coke	7 00

ANTHRACITE.

Grate, screened	$7 50	Stove, screened	$7 75
Egg, "	7 50	Chestnut "	7 50
Lehigh Lump	9 00		

40 cents to $1 per ton additional for delivery at retail.

Toronto, Ont. Jan. 4, 1876.

The coal trade here is very dull owing to a continuance of mild weather, but we are hoping for a change before long. The price of hard coal has been advanced for this month 25c. per ton.

The importation of the season just closed have exceeded those of the preceding season by about 20,000 tons.

The prices are as follows, per ton of 2000 lb., delivered:

Chestnut	$7 25
Stove	7 50
Egg and grate	7 75
Bituminous coal for domestic use	6 00
" " steam	3 50@5 50
Lehigh Lump and broken	7 50
Blossburgh	6 50

Halifax, N. S. Jan. 1, 1876.

Prices per ton of 2240 lb. in gold.

Sydney (old mines)	$4 00	Little Glace Bay	3 35
Gowrie	3 35	Blockhouse	3 35
Victoria	—	Albion (at Railroad)	4 00

Montreal. Jan. 1, 1876.

Specially reported by Messrs. ROBERT C. ADAMS & Co.

Wholesale per ton of 2240 lb.

Scotch Steam	$6 00	Cape Breton Steam	$5 25
Pictou "	5 75	Newcastle Smiths,	7 00

Anthracite at retail, per 2000 lb., delivered.

Egg	$8 50	Chestnut	8 25
Stove	9 00		

Rates of Transportation on Anthracite Coal to Tide Ports.

Lehigh and Wyoming Coals, per ton of 2240 lb.	From Penn Haven.	From Mauch Chunk.	From Hazleton**	From Upper Lehigh.	From Ashley and Sugar Notch.
To ‡ Newark, N. J. (117 miles), via Central Railroad of New Jersey	2 60	2 46	2 93	2 93	3 16
‡ Mauch Chunk, Pa., via Central Railroad of N. J.	14	..	56	47	71
† Philipsburg, N. J., (46 miles)	99	85	1 32	1 32	1 65
Elizabethp't, (114 m.) Pt. Johns., Hoboken & South Amboy, N. J., shipping and wharfage 35c. add.	2 24	2 10	2 59	2 57	2 80
High Bridge, N. J.	2 40	1 95	2 80	2 54	2 72
Somerville and Raritan, N. J.	2 80	2 35	3 20	2 35	3 12
Elizabeth, Cranford, Westfield & Elizabethport, for consumption,	2 60	2 46	2 95	2 93	3 16
¶ Jersey City, N. J., (121 miles) and New York, via L. V. RR.	2 85	2 40	3 17	3 24	3 54
Andover, via Delaware, Lackawanna and Western RR.	3 30	3 10	3 70	3 69	3 99
Trenton Somerset Junction and Greensburg, via P. RR. Belvidere Division	2 65	2 45	3 05	3 04	3 34
Trenton, (97 m.) for shipment, including shipping and wharfage	2 11	1 95	2 45	2 46	2 76

From *Mauch Chunk* to *New York* (121 miles), (towing limits) and Jersey City† via Lehigh Valley RR. $2 37

From *Mauch Chunk* to *Philadelphia* (93 m.) via L. V. RR. and North Penn. RR 1 75

††From *Phillipsburg, N. J.* to *Hoboken* (84 m.) for shipment via Delaware. Lackawanna and Western RR., Morris and Essex Division 1 24

From *Lackawanna Junction* to **Auburn, N. Y.*, (191 m.) for shipment, via Southern Central R.R. in connection with Pa. and N. Y. R.R. 2 53

From *Lackawanna Junction* to ‖*Weedsport* (201 m.), for *Rochester and Charlotte* 2 59

From *Lackawanna Junction* to *Sterling* for *Oswego, N. Y.* .. 2 62

‖ To this point for all places between Rochester and Buffalo the rate is 2 53

* The rate to this point for Syracuse is 2 03

** Rates on line coal from Hazleton are 10c. per ton above these figures.

‡ The cost of unloading is to be added to these rates. No charge less than 40c. per ton will be made for any distance. Tolls from Mauch Chunk to Phillipsburg for way points will be $1 15 per ton.

§ Twenty cents per ton less when five cars at a time to one party. Provided that where the reduction makes the rate $1 a ton, or less, the rate will be $1.

¶ 20 cents per ton additional for transferring coal from boat to boat, and 30 cents per ton for reshipment of same from wharves.

† Transportation on Coal destined for re-shipment from this point is 20c. less than above rate.

†† The rate for consumption to this point is $1 80.

The distances in the above table are computed from *Mauch Chunk*. From *Ashley* to *Mauch Chunk* the distance is 51 miles, and from *upper Lehigh*, 33 miles. From *Hazleton* 24 miles, and from *Penn Haven* 8 miles.

From *Wilkes-Barre* to *Perth Amboy* via the Lehigh Valley Railroad Company, the distance is 161 miles, and from *Mauch Chunk* it amounts to 106 miles.

Schuylkill Coals, per ton of 2240 lb.	From Pine Grove	From Tamaqua.	From Port Carbon.	From Mount Carbon.	From Schuylkil Haven.
To *Port Richmond*, for shipment, via P. & R. R. R., Main Line	2 12	2 07	2 00	1 99	1 92
Philadelphia, Retail yards	2 22	2 17	2 10	2 09	2 02
Harrisburg, via Lebanon Valley Branch	1 35	2 02	1 95	1 94	1 87
Allentown, via East Pennsylvania Branch	1 70	1 65	1 58	1 57	1 50
Lancaster, and Points on Lancaster Branch, via R. & C. R.R	1 82	1 77	1 70	1 69	1 62
Dauphin, via Schuylkill and Susquehanna Branch	85	....	1 43	1 42	1 35
Slatedale Junction via Berks and Lehigh Branch	1 88	1 83	1 76	1 75	1 68
Lebanon, via Lebanon and Tremont Branch	96	....	....	....	....

From *Tamanend* to *Catawissa*, via Catawissa and Williamsport Branch Railroad 94

From *Tamanend* to *Williamsport*, via Catawissa and Williamsport Branch Railroad 1 39

Coal sent to points on the Catawissa and Williamsport Branch will be charged one and one-half cent per ton per mile, and two cents per ton additional to Tamanend.

The rates of freight and tolls on lump and steamboat coal (except that sent to Richmond for shipment) will be twenty per cent., and on broken coal will be ten per cent. less than the above rates.

Freights.

Per ton of 2240 lb.

Representing the latest actual charters up to Jan. 6, 1876.

PORTS.	From Philadelphia.	From Baltimore.	From Georgetown.	From Elizabethport, Port Johnson, South Amboy, Hoboken and Weehawken.¶
Augusta, Me.	....	2 40	....	....
Albany	*85	1 70	....	....
Amesbury, Mass.	....	....	....	....
Bangor, Me.	†2 00	3 00	....	2 10
Bath, Me.	1 60	2 75	3 00	1 30
Baltimore	....	....	....	....
Boston, Mass.	§2 00	2 50	2 50	1 90@§2
Bridgeport, Ct	*85	1 70	2 10	90
Bristol, R. I.	....	....	2 15	1 00
Cambridgeport, Mass.	§1 90	....	2 70	2 00
Derby	....	1 65	....	....
Dighton	....	1 70	....	....
East Cambridge	1 90§	....	2 75	§2 00
Fall River	1 50	1 75	....	1 00
Hackensack	....	....	....	....
Hallowell, Me.	....	....	....	....
Hartford	....	1 65	....	....
Hoboken	†85	1 40	1 80	40
Hudson	....	1 65	....	....
Jersey City	....	1 40	1 80	40
Lynn, Mass.	†2 10	....	....	†2 05
Middletown	....	....	....	1 25
Mystic	....	....	....	....
Newark	....	....	....	....
New Bedford	1 50	1 75	2 15	90
Newburyport	2 10	2 75	2 80	2 10
New Haven	*85	1 70	2 10	85
New London	1 50	1 70	2 10	1 00
Newport	1 50	1 65	2 10	1 00
New York	85††	‖1 60	1 85	40
Norfolk, Va.	85	60	60	....
Norwalk	85‡	1 50	....	80
Norwich	1 50‡	1 90	....	1 00
Pawtucket	1 75‡	1 65	2 20	....
Philadelphia	....	80	....	....
Portland	1 95	2 50	2 85	1 60
Portsmouth, N. H.	2 05@2 10	2 60	3 00	2 10
Providence	1 50	1 85	2 10	1 00
Petersburg, Va	....	90	....	....
Portsmouth, Va.	....	....	....	....
Poughkeepsie, N. Y.	....	1 50	....	....
Richmond, Va.	1 00	70	....	....
Rockport.	....	....	....	....
Saco	2 50	....	....	....
Sag Harbor	....	....	....	1 00
Salem, Mass.	2 00	2 50	2 80	2 05
Salisbury Pt., Mass.	....	....	....	....
Savannah, Ga.	....	1 50	....	....
Stamford	*85	....	....	90
Stonington	....	....	....	....
Taunton	.. .	..	....	....
Trenton, N. J.	....	....	....	....
Troy	...	....	....	....
Warren, R. I.	....	....	....	1 00
Washington, D. C.	1 00	....	....	....
Wareham	....	1 75	....	....
Weymouth	2 00	2 25	2 80	....
Wilmington, Del.	....	85	....	....
Wilmington, N. C.	....	1 50	....	....

* And discharging and towing. † And discharging.

‡ And towing. § 3c. per bridge extra.

‖ The rate to this point by barge is $1 70. †† Afloat.

From Philadelphia to all accessible places on the Hudson River the rate is 85c., and discharging and towage according to destination.

¶ These rates are very irregular and our quotations may be considered nominal.

Freights on Bituminous Coals from the Mines to Tide-Water Shipping Ports.

From the Mines to Cumberland and State Line (say an average of 20 miles) the charge is 3 cents per ton of 2240 lb. per mile.

From State Line to Amboy (346 miles) $3 75 per ton of 2000 lb. On coal shipped beyond this point there is a drawback of 50 cents per net ton.

From Cumberland to Baltimore (178 miles) $2 31 per ton of 2240 lb., or $2 02 per net ton, and 4 cents per gross ton for use of cars.

From the Mines to Piedmont (from 4 to 10 miles) 5 cents per ton of 2240 lb. per mile on distances less than 5 miles, and 4 cents per ton per mile on distances not over 10 miles.

From Piedmont to Baltimore (206 miles) $2 69 per ton of 2240 lb., or $2 40 per net ton.

From any point in the Kanawha Valley to the James River wharves below Richmond, (say 350 miles) by C. and O. R.R., including terminal charges, per ton of 2240 lb. For Cannel coal, $4 50.

Do. do., for Semi-Cannel or Splint, per ton of 2240 lb., subject to rebate on shipments of 500c tons or more, $3 65.

From Irwin to W. Phila (say 332 miles) per P. R. R. Penn. Westmoreland gas coal, per ton 2000 lb. $4 75

From Osceola to W. Phila (say 248 miles) per T. & C. R. R., per ton bituminous coal of 2000 lb., 5c. extra for cross roads. Drawbacks, according to destination of coal 3 50

From Fairmount and Clarksburg to Baltimore (say 300 miles) via B. & O. R. R. including loading, per 2000 lb 4 75

On through coal after deducting drawback .....

From Richmond, Va., to New York, via vessel, 392 miles per 2240 lb.. 1 60

" " " *Boston*, about 650 " " " 2 00

" " " *Philadelphia*, 292 " " " 1 25

From the Mines to Richmond, via James River and Kanawha Canal, 15 miles 15

Scotch Pig Iron Market.

GLASGOW, December 21, 1875.

There was a very extensive business done in Warrants during the latter part of the past week, at prices slightly under those which were current a few days before. The lowest point touched was 62/3, and the closing price on Friday was 62/6 cash buyers.

On Monday there was a very brisk market, numerous transactions taking place from 62/6 to 63/3 cash, and closing at the best.

To-day there has again been an extensive business transacted from 63/3 cash, and 63/6 one month to 63/6 cash and 63/9 one month, closing with buyers at the latter prices and sellers 1d. per ton higher.

There is no change to report in Makers' Iron, but the demand is good and the tone of the market quite firm.

	No. 1	No. 3
G. m. b. at Glasgow (deliverable alongside)	64/6	63/
Gartsherrie, " "	74/	65/6
Coltness, " "	77/6	66/6
Summerlee, " "	70/	64/
Glengarnock, at Addrossan, "	70/	65/
Eglington, " "	64/5	63/6
Bar Iron	£80/ to £8 10/	
Nail Rods	£90/	

SHIPMENTS.

Week ending 18th December, 1875	8,156 tons.
" 19th December, 1874	7,324 "
Increase	832 "
Total Increase for 1875	82,468 "

IMPORTS OF MIDDLESBRO' PIG-IRON INTO GRANGEMOUTH.

Week ending 18th December, 1875	3,850 tons.
" 19th December, 1874	2,390 "
Increase	1,460 "
Total Increase for 1875	19,225 "

WILLIAM COLVIN & Co.

John H. Austin & Co's Rail Circular.

LONDON, E. C., Dec. 22, 1875.

American rails 50@60 lb. per yard, £6 7/6@£6 10/ per ton f. o. b. Wales; American Rails 50@60 lb. per yard £6 7/6@£6 10/ per ton f. o. b. East Coast; Steel rails, £8 10/@£9 per ton f. o. b. Wales; Steel rails, £9 10/@£10 per ton f. o. b. Liverpool or East Coast.

Robert Crooks & Co.'s Metal Report.

MOLYNEUX PLACE, 18 WATER STREET, LIVERPOOL, 23d Dec., 1875.

TIN PLATES.—For some time back it has only been a comparatively small proportion of makers who were willing to book at the lower prices. The others preferred reducing production, and working quietly along on small specifications, for which they were getting more remunerative rates. Now, those manufacturers who quoted low are fairly supplied with orders, and require increased figures, so that, prices will show, there is now less difference between the various makers' estimates of equal brands.

PIG IRON.—The decline in the market for warrants mentioned in our last, continued to end of the week, when the price was 62/ 3d buyers. This week we have had a firmer market, business being done on Monday from 62/ 6d to 63/ 6d, closing with buyers at 63/ 6d. On Tuesday transactions were at 63/ 9d to 63/ 6d, and yesterday a large business was done at these figures, closing buyers at the latter. Makers' prices are:—No. 1 Gartsherrie, 73/ 6d; Coltness, 77/ 6d; Summerlee, 70/ 6d; Monkland, 64/ 6d, f.o.b. Glasgow; Glengarnock, 69/ 6d; Eglinton, 64/, f.o.b. Ardrossan. Shipments for week ended 18th instant, 8,156 tons. Stocks on 17th instant, 63,989 tons.

From Middlesboro' we have the following report, dated Tuesday—"Market is very firm, with a fair business doing. All makers ask an advance in prices, and consumers now show more inclination to purchase for forward delivery. Prices are:—No. 1, 53/ 6d; No. 2, 51/; nett f.o.b. Tees."

FINISHED IRON.—Owing to the proximity of the holidays, and the previous slackness, there is very little doing. Prices are maintained at from £7 12/ 6d. to £8, for Crown bars; hoops, £9 2/ 6d. to £9 5/. The Scotch makers advise us this morning they have raised their prices for bars 10/ per ton.

TIN.—No change to note, very few transactions taking place, and quotations remaining—L. & F. ingots, £84 10/; bars, £85 10/; grain bars in barrels, £89 10/; granulated, £91 10/.

COPPER.—With liberty to select any good, useful brands, the following limits would now be workable: tough ingots, £87; best selected, £88; sheets, £96.

LEAD has advanced in value this week, and is expected to go still higher in the course of the next few weeks. Spanish pig is coming forward very scantily; and English is taken almost entirely for manufacturing purposes, leaving only a few lots for export. The lowest quotations are: Spanish pig, £22; English, £22 7/ 6d.; sheet, £23 10/; water pipe, £24; gas pipe, £24 10/.

FREIGHTS.—New York, 12/ 6d.; Boston, 12/6d.; Baltimore, 7/ 6d; Philadelphia, 15/; Montreal, 30/; Quebec, 35/; Toronto, 31/; Hamilton, 31/.

IRON MARKET REVIEW.

New York.

FRIDAY EVENING, Jan. 7, 1876.

American Pig.—We note sales of 1,200 tons of No. 1 Thomas iron, at $23, and 200 tons of No. 2 foundry at $21. With these exceptions we learn of no business worthy of note. Quotations are: No. 1 foundry, $23; No. 2, $21; and forge, $15@20. There has been but little good No. 1 iron sold for less than $23, while some are asking even more, although a higher price cannot be secured on ordinary quantities and regular time. There appears to be a disinclination to make season contracts at the present prices, although we are informed that some have been made. The outlook is by no means encouraging, and prices have rather a downward than an upward tendency.

Scotch Pig.—The stock is small, in strong hands, and firmly held. Owing to the great difference between the cost of American and Scotch irons, the business doing in the latter is confined mostly to small lots, the aggregate of which, for the week, was 250 to 300 tons, mostly Coltness and Eglinton, on private terms. The business outlook for this article in the early future is a very gloomy one. We quote Eglinton, $29.50@30; Glengarnock, $31; Coltness, $32.50@33; and Gartsherrie, $32.50. These are the only brands in the market.

Rails.—One of our contemporaries has reported a sale of 10,000 tons of 50 lb. rails, in bond, at New Orleans. There is not that quantity there. The report, probably, refers to negotiations going on for the sale of 1000 tons 50 lb. rails, but which sale, we believe, is not fully consummated. There are some inquiries in the market which are likely to result in business at an early day. We quote iron rails, at mills, at $42@48, and steel at $65@70.

Old Rails.—There has been no further business in these, so we continue $22.50 as a nominal quotation, although it is intimated that they can be bought at $20. The large substitution of steel for iron rails will tend to a constant increase of the stock of old rails for a long time to come.

Scrap.—We are reported no transactions, and in the absence of business quote nominally at $30@31.

Phi'adelphia, Pa.

Weekly report of the Philadelphia Iron Market, furnished by Messrs. JUSTICE COX & Co., Iron Merchants, 333 Walnut street Philadelphia Week ending Jan. 6, 1876.

The New Year comes in with few changes in iron firms; those in can not get out without loss, and those out not anxious to get into anything showing so little profit as iron. As acknowledged by all, the iron business is the poorest of any business in the country to-day, considering the amount of money invested. There is no change in prices since our last; no large sales, but quite a number of small lots for immediate wants have changed hands. We hear of sales of 100 tons No. 1 St. Charles in lots, $24; 200 tons No. 2 Montgmery, at $22; 100 tons Grey Forge Mentgerry, at $21; 500 tons No. 1, 2 and 3 Crane, in lots, at quotations. We quote No. 1, $23 to $24; No. 2, $21 to $22; Grey Forge, $20 to $21. There is more business in bar iron this week than for some months past, quite a lively demand. Prices are no better, but if the demand will come the price now so low, and in many cases under the cost of production, must advance. We quote 2 4-10ths at 2 5-10ths.

Old Rails are quoted	$23@$25
New Iron Rails	$44@$46
Muck Barr	$38@$41

Baltimore. Jan 5, 1876.

Specially reported by Messrs. R. C. HOFFMAN & Co.

We have no change to report in the iron market since our last report. Sales small at about quotations:

Baltimore Charcoal	$32@35	Anthracite No. 3	$21@22
Virginia Charcoal	28@34	Mottled and White	17@19
Anthracite No. 1	25@26	Charcoal C. B. Blooms,	70@75
" No. 2	23@24	Refined Blooms	60@65

Boston. Jan. 6, 1876.

Specially reported by E. P. CUTLER & Co.

We have nothing of interest to report in relation to the iron trade; the prices for pig metal rule about as heretofore. The increased prices of freight and insurance on winter rates keep the store prices steady.

There has been an arrival of Scotch iron, the first for a long time, most of which goes into store. Bars are quiet and prices still rule low; trade dull and unsatisfactory.

PIG is without life or interest, quoting as last noted from $19 to $26, according to brand.

BAR has had a dull week, not an unusual incident for the last days of the year. Prices are unchanged, $51 50 for guaranteed refined being the uniform jobbing price Common iron is without quotation or sale.

STEEL is very quiet, a lull hardly anticipated from the inquiries made a week ago. Prices are unchanged.

We quote American tool, 14@15c.; American Machinery, 9@9½c.; Bessemer tires, 6¾@7¼c.; Sweet's Excelsior tire, 8½@12c.; English tool, 16@18c., gold.

COPPER remains in a stupid and steady position, quoting 23⅜ to 23½c. for spot or futures, according to the wants of buyers.

For manufacturers we quote New Sheathing, 30c.; bolts and braziers, 31c.; yellow metal bolts, 20@29c.

LEAD is quiet and steady. Stocks are still very light, and very little offering to arrive.

We quote pig 6c. for domestic and 6⅜@6½c. for foreign; sheet and pipe lead. 9c., currency; tin-lined pipe, 16½c.; bar lead, 9c., less usual trade or 10 per cent. discount.

ANTIMONY is firm, with a small inquiry at 13½c.

SPELTER is strong and quiet at $7 45, 30 days, and $7 35, prompt cash, all currency. Silesian is dull at $7 75.

TIN is without interest in either pig or plate. The market continues steady.

We quote Straits, 19½c.; Banca, 24c.; Refined English, 19½c., gold. Plates are active. We quote Charcoal I. C., $7 50; coke, $6 75@7; and Terne at $6 30@$6 75, gold.—*Commercial Bulletin.*

Cincinnati. Jan. 4, 1876.

Specially reported by Messrs. TRABER & AUBERY, commission merchants for the sale of pig iron, blooms, ore, etc.

Below please find closing quotations of our pig iron market:

CHARCOAL.

Hanging Rock, No. 1 Foundry	$25 00@	....—4 mos
" No 2, "	23 00@24	00—4 mos
" Mill	22 00@	...—4 mos
Tennessee No. 1, Foundry	23 00@24	00—4 mos
Tennessee, No. 2, "	22 00@23	00—4 mos
" Mill	22 00@	....—4 mos
Missouri, No. 1, Foundry	@	....—4 mos

STONE COAL.

Ohio, No. 1, Foundry	22 00@23	00—4 mos
" No. 2, "	21 00@22	00—4 mos
Ohio Mill	20 00@21	00—4 mos
Missouri, No. 1 Foundry	27 00@28	00—4 mos
" No. 2, "	26 00@27	00—4 mos
" Mill	26 00@27	00—4 mos

CAR-WHEELS.

Hanging Rock, C. B	40 00@50	00—4 mos
Tennessee "	30 00@35	00—4 mos
Missouri "	35 00@40	00—4 mos
Alabama "	30 00@35	00—4 mos

BLOOMS.

Charcoal	60 00@ 75	00—cash

SCRAP IRON.

Cast	50c.@ 65	—cash
Wrought	90@1 00	—cash

Chicago. Jan. 4, 1876.

Specially reported by Messrs. ROGERS & Co., dealers in Scotch and American pig iron.

No change in prices.

No. 1 Coltness	$40 00@ ....
No. 1 Gartsherrie	40 00@ ....
No. 1 Summerlee	38 00@ ....
No. 1 Glengarnock	37 00@ ....
No. 1 Eglinton	36 00@ ...
Warner's "American Scotch"	34 00@ ...
Massilon No. 1 Foundry	31 00@ ...
No. 1 Grand Tower Mo. ores (Bituminous)	29 00@ ...
No. 2, " " "	28 00@ ....
No. 1 Mill	25 00@ ...
No. 1 Foundry, Ohio	28 00@ ....
No. 2 " "	27 00@ ....
No. 1 Hanging Rock (charcoal)	30 00@ ....
No. 2 " " "	24 00@ ....
Union "A" 1 (Anthracite)	28 00@ ....
Union "B" 1 (Anthracite)	26 00@ ....
No. 1 Lake Superior (charcoal)	30 00@ ....
No. 2 Lake Superior "	28 00@ ....
No. 3 Lake Superior "	30 00@ ....
No. 4 Lake Superior "	32 00@ ....
Bessemer Steel Rails	72 00@ ....
New Iron Rails	50 00@ ..
Old Rails	28 00@ ....

Cleveland, Ohio, Jan. 5, 1876.

Messrs. C. E. BINGHAM & Co., quote as follows:

Per gross ton, on four month's time. Subject to change in market. Discount for cash 4 per cent.

FOUNDRY IRON.

No. 1, Lake Superior Charcoal	29 00@....
No. 2, "	28 50@....
No. 1, Anthracite	26 50@....
No 2, "	25 00@....
No. 1, Bituminous foundry	26 50@....
No 2, " "	25 00@....
American Scotch, No. 1, Cherry Valley	29 50@....
" " B—1, " "	27 50@....
" " No. 2, " "	26 00@....
No. 1, Massilon	28 00@....
B—1, "	26 00@ ...
No. 2, "	23 00@ ...

CAR WHEEL AND MALLEABLE IRON.

No. 3 Lake Superior Charcoal	27 50@....
No. 4 " " "	29 00@....
Nos. 5 and 6 " "	29 00@....

BESSEMER IRON.

Nos. 1 and 2 Lake Superior Charcoal	28 50@....

FORGE IRON.

No. 1, Gray	23 00@....
White and Mottled	22 00@ ..

Indianapolis, Ind. Jan 4, 1876.

Specially reported by NELSON KINGMAN, broker and dealer in pig iron, etc.

Prices remain the same.

Trade very dull at prices named below.

New Rails at mill	$48 00@50	00	
Old Rails "	24 00@20	00	
Hanging Rock Charcoal Pig No. 1 foundry	28 00@29	00—4 mos
" " " " 2 "	26 00@28	00—4 mos
" " " " Mill	24 00@26	00—4 mos
Car Wheel C. B.	40 00, nominal.	

STONE COAL.

Indiana No. 1 Foundry pig Red Short	24 00@26	00—4 mos
" 2 " " "	22 00@24	00—4 mos
" 1 Forge " "	....@	....—4 mos
" 2 " " "	....@	....—4 mos
Ohio No. 1 Foundry pig Cold Short	25 00@26	00—4 mos
" 2 "	24 00@25	00—4 mos
" Mill	23 00@24	00—4 mos
" No. 1 Foundry, Neutral	26 00@28	00—4 mos
" No. 2 " "	25 00@27	00—4 mos
Merchant Bar		2½c.—3 mos
1st quality C. H. No. 1 Boiler Plates, per lb		5 c—3 mos
1st " Com. Sheet for No. 24, W.G. "		4 c.—3 mos
1st " Charcoal Sheet " " "		5½c.—3 mos
Best Bloom Galvanized Sheet, discount 20 per cent		—cash.
2d quality " " " 30 "		—cash.

f. o. b. in Indianapolis.

Louisville. Jan. 4, 1876.

Specially reported by Messrs. GEORGE H. HULL & Co.

The market is dull, but without change in prices.

The usual time, four mos., is allowed on the quotations below:

HOT BLAST—CHARCOAL.

No. 1 foundry, from Hanging Rock Ores	$25 00@26 00
No. 2 " " "	23 00@24 00
No. 1, Mill, from " "	—@—
No. 1, foundry, from Alabama, Georgia and Tennessee ores	23 00@24 00
No. 2, foundry, from Ala., Geor'a and Tenn. ores	22 00@23 00
No. 1, Mill, from " " " "	21 00@22 00

HOT BLAST—STONE COAL AND COKE.

No. 1, foundry, from Hanging Rock ores	23 00@24 00
No. 2, " " " " "	22 00@23 00
No. 1, Mill, " " " "	21 00@22 00
No. 1, foundry, from Ala. Ga. and Tenn. ores	23 00@24 00
No. 2, " " " " "	22 00@23 00
No. 1, Mill, " " " "	21 00@22 00
No. 1 foundry, from Missouri ores	24 00@25 00
No. 2 foundry, from Missouri ores	24 00@25 00
No. 1 Mill, from Missouri ores	25 00@26 00

COLD BLAST—CHARCOAL.

Car Wheel from Hanging Rock ores	35 00@40 00
" " Tennessee "	28 00@30 00
" " Alabama and Georgia ores	28 00@38 00
" " Kentucky ores	28 00@40 00

Milwaukee. Jan. 4, 1876.

The following are the present prices, per ton of 2,240 lb.:—

Frankfort L. S. Charcoal, No. 1	$30 00
" " " No. 2 & 3	28 00
" " " No. 4 & 5	31 00
" " " No. 6	35 00
Mil. Anthracite L. S., No. 1	30 00
" " " No. 2	28 00
Wisconsin Iron, No. 1	26 00
Mahoning Valley Bit's No. 1	32 00
" " " No. 2	30 00

Pittsburgh. Jan. 5, 1876.

Specially reported by A. H. CHILDS, Esq.

There is, as yet, very little change to report in the condition of the metal market.

Prices remain the same, but there is some inquiry on part of buyers, and some disposition manifested to purchase more largely, provided suitable prices can be obtained. On the whole, the tone of the market is rather more favorable than for some weeks past.

PIG IRON.—The general position of the market remains substantially as noted from week to week for several months past. One of the most important reasons for expecting an increased trade, lies in the fact that the mills generally have very light stocks, some of them are almost bare; then again, the impression is gaining ground that prices have touched hard pan, and this is strengthened by the fact that even taking the reduced manufacture into consideration, current rates do not cover actual cost of production. Furthermore, stocks are very much reduced, not only here but at those points tributary to this market, and even if prices should be advanced slightly, it is not likely that those furnaces stopped will blow in again before spring, if then. As noted in our last report, the stock of charcoal iron is down lower than it has been for a year or more past, some of the brokers report that they have closed out entirely, and consequently there is a firmer feeling, without, however, any quotable improvement in prices; charcoal iron declined more than either coke or coal smelted, and the increased demand may be attributed to the fact that for some time past there has been but little difference in the cost of it and other kinds, and consumers gave it the preference because of its yielding a better quality of product. The general outlook at the present writing warrants the expectation of an increased demand within the next few weeks, and the fact that prices are low, below the cost of production, will have a tendency to increase the demand, as consumers generally will be inclined to anticipate future wants.

QUOTATIONS.

No 1. foundry	$25 00@26 00—4 mos
" 2. "	23 00@24 00—4 mos
Gray forge	22 00@22 50—4 mos
White and mottled	20 00@21 00—4 mos
Charcoal, No. 1 foundry	27 00@30 00—4 mos
Charcoal mill	22 00@23 00—4 mos
Cold blast car wheel, Eastern	30 00@35 00—4 mos
" " Western	40 00@45 00—4 mos

MANUFACTURED IRON.—Trade in manufactured iron is very dull, but there is reason to believe that there will soon be an increased demand. Stocks are light, both in hands of jobbers and consumers; this is evident in view of the fact that the demand during the past year was confined almost entirely to supplying immediate wants, and then it is generally believed, and we think there is not much doubt of it, and prices have reached the lowest notch, which of itself will have a tendency to stimu-

late trade, as buyers, if satisfied that hard pan has been reached, will naturally feel inclined to anticipate future wants. Quotations may be given upon a basis of $2 20@ 2 25 for merchant bars, although it is intimated that orders for round lots have been placed at from one to two-tenths less.

STEEL.—There is a continued fair degree of activity, as much so as can reasonably be expected at this particular time, and the outlook warrants the prediction that there will be at least an average healthy spring trade Our manufacturers generally had a very fair trade during the year so recently closed; the most of them had about all they could do, although it is claimed that in consequence of an active competition, prices were cut so close that there was little or no margin for profit. For some kinds of steel there is a very fair demand now, and orders for all various grades will no doubt commence to come forward pretty freely within the next few weeks.

STEEL RAILS.—Trade remains substantially as noted in our last review, no new or important feature deserving of special notice. Quotations may be fairly given at $65@67, cash, delivered on cars in Pittsburgh. The mills generally are pretty well supplied with orders, and the indications are that they will have about all they can do this year, as they had during the year just closed. Iron rails continue very dull, all the leading roads needing rails are buying steel; as, taking wear and tear into consideration, they are much cheaper than iron.

PIG METAL SALES REPORTED FOR THE AMERICAN MANUFACTURER FOR THE WEEK ENDING JAN. 5, 1876.

BITUMINOUS COAL OR COKE, SMELTED FROM L. S. ORE OR L. S. ORE AND NATIVE.

100 tons No. 1 foundry..... .....$24 00—4 mos.
200 tons gray forge..... ..... 22 50—4 mos.
210 tons gray forge..... 22 00— 4 mos.
500 tons gray forge..... 22 00—4 mos.

CHARCOAL.

310 tons Nos. 1 and 2 foundry, H. R..... P. T.

—*American Manufacturer.*

Richmond, Va. Jan. 5, 1876.

Reported by ASA SNYDER, Esq.

There is is a decided firmness in the market for cold blast charcoal pig irons. There has been active inquiry since the year opened, and sales of over three hundred tons from the small stock carried over into the new year. Receipts are very light. Quotations remain as before.

San Francisco.

From the *Commercial Herald*, Dec. 23, 1875.

Business in all departments is very dull, as is usual at this season of the year. Stocks of pig iron are excessive, and prices altogether nominal. The trade demand for assorted manufactured iron and steel is good for this time of year, while the prospect ahead for 1876 is more promising than ever before. The consumptive demand by miners and mill owners and foundrymen generally promises to be very great in the near future—far greater than ever before in our history. We omit quotations, which are altogether nominal for lack of any invoice sales.

St. Louis. Jan. 4, 1876.

Specially reported by Messrs. SPOONER & COLLINS, Commission Agents for all kinds of Iron.

Our market is still in a dull condition prices are very low, with very light demand.

Montreal. Dec. 28, 1875.

We quote pig iron:—Eglinton and Clyde, $21@21 50; Carnbroe, $21 50@22; American, $24@26; Summerlee and Calder, $22@23; Langloan and Gartsherrie, $22@ $23; Coltness, $22 50@23 50; Hematite, $30@31. Bar, per 100 lb., Scotch and Staffordshire, $2 30@2 40; best do., $2 50@2 60; Swedes and Norway, $5@5 50; Lowmoor and Bowling, $6 50@7.—*Monetary Times.*

Imports at New York.

The New York *Shipping List* gives the following as the imports at New York during 1875, as compared with 1874:

IRON.	BAR. Tons.	PIG. Tons.	SHEET, &c. Bdls.
From foreign ports.....	8,076	21,073	35,622
Coastwise.	958	428	12,677
Total	9,034	21,501	48,299
Same time, 1874. ...	3,658	60,901	57,891

LEAD.	Pigs.
From foreign ports	89,700
Coastwise ports	97,430
Total	187,130
Same time, 1874	386,167

TIN.	1875.	1874.
Pigs.....	No. 88,365	165.483
Plates ...	bxs.838,042	966,871

SPELTER.	
1875 ..... plates.	43,734
1874.. ..... "	85,659

METALS.

NEW YORK, FRIDAY EVENING, Jan. 7, 1875.

Most firms are engaged closing up the business of 1875; taking account of stock etc., and but little has been done during the week as is usual at this period of the year.

Messrs. JAMES & SHAKSPEARE, of London, under date of Dec. 25, say:—"Trade in metals has been dull since we last wrote; prices, however, are fairly maintained, and a slight increase in the demand would at once cause an advance in most of our leading articles. The consumption of copper, tin and lead during the present year has been fully up to, if not surpassing, the usual average; and it is only the entire absence of speculation which causes us to close with quotations below those ruling at this time twelve months ago."

Gold Coin.—During the week past gold has ranged from 112⅜@113⅛, and closed at 112⅜.

Bullion.—Fine silver bar is quoted at $1 21@$1 22 gold, per ounce, and fine gold bar at par ($20 67, gold, per ounce,) to ¼ per cent. premium.

Copper.—There has been but very little business done since our last, with cash sales at 23c. The asking prices to-day are 23c.@23¼c. Chili Bars were quoted in London, yesterday, at £81.

Messrs. JAMES & SHAKSPEARE say of copper:—"No sale has transpired either in ore or regulus, since the 17th instant. Bars show a reaction of about 10/ per ton from the values lately paid; but the quantity offered for sale is moderate, and chiefly confined to ordinary brands, special and picked marks being exceedingly scarce. There seems to be but little doubt that the *Esk*, (chartered direct for Havre, with about 500 tons on board) is really lost, and this may have some influence on quotations, when all doubt on the subject is removed. Australian meets with more inquiry. Orders, however, are still limited at too low figures to permit of execution, except in rare instances. English remains quiet, but smelters show no inclination to give way in price as consumers are believed to be only barely supplied for next year."

Tin.—Straits was quoted, in London, yesterday, at £81 10/, and at Singapore, $22¼ per picul. There has been but very little business done since the beginning of the year. We quote Straits in lots of 500 and 1,000 pigs at 18¼c., gold, per lb., and in lots of less than 100 pigs, at 19¼c.; L. & F. in lots of 500 to 1,000 pigs, at 18¼c., and in lots of less than 100 pigs, 18⅛c. Banca is quoted in all quantities at 23c., gold, and Refined English at 18⅜c.

Messrs. JAMES & SHAKSPEARE say of tin:—"The inquiry for English is steady, and quotations remain without change. Foreign descriptions show no alteration in value; but it would seem that operators for a fall are desirous of closing their accounts, as forward parcels, both of straits and Australian, have lately sold at, and slightly above, cash values."

Tin Plates.—There is but little busines doing in these. Quotations are as follows per box, gold: Charcoal tins, $7.50@7.75; and ternes, $7@7.25; coke tins, $6 62½@6.68½; and ternes, $6.37½@6.50.

Lead.—We are reported sales of 100 tons of ordinary Domestic at 5·90c., gold, and 75 tons in lots at the same figure. We quote to-day at 5·87½@5·90c. Missouri soft is quoted at 7¾c., currency. Foreign is nominally quoted at 7½c., gold.

Spelter and Zinc.—There is but very little doing in spelter. Domestic is firmly held at 7·40c., currency, 30 days. Foreign is quoted at 7·27½@7·40c., gold. A meeting of Producers of Domestic was to have taken place in Chigaco to-day. Sheet zinc is quiet at 9c.

Antimony is quiet, but firm, at 14½@14½c, gold.

Quicksilver.—The quotation in this city is 70c, and in San Francisco, 62½@65c., gold, per lb.

Messrs. JAMES & SHAKSPEARE quote quicksilver per bottle of 75 lb., at $11 nominal, and say:—"It has dropped another 20/, but these frequent changes do not excite much attention, buyers being now accustomed to the rapid fluctuations which sometimes take place to the extent of £2 to £3 per week."

The San Francisco *Commercial Herald* of December 23, says:—The London quotations have suddenly dropped from £13 down to £11. The *Gaelic*, hence for Hongkong, December 16th, carried 384 flasks, and for Japan 46. The *Constitution* for Mazatlan had 100 flasks, and for San Blas 616. The export demand during the current week has been light, and prices more or less nominal, being within the range of 65@67½c. The production of the mines upon the Pacific slope is steadily augmenting, and the beauty of it is that the world's consumption takes it from us as fast as it is brought to market, at the current price.

FINANCIAL.

New York Stocks.

FRIDAY, Jan. 7, 1875.

The New York Stock Market has been fairly active during the week with prices fully sustained. Bonds are firm with an increase in the transactions. The first mortgage bonds of the Chesapeake and Ohio R. R. have advanced to 33 in the final dealings, from 28 the price recorded in our last, this advance is undoubtedly influenced by the following decision of Judge BOND: Chief Justice WAITE concurring, at Alexandria, Va., on the 3rd inst., in the case of A. F. RICHARDS and others, against the Chesapeake and Ohio Railroad Company, transferring the receivership of the road from HENRY TYSON, who is supposed to represent the Baltimore interest, to General WICKHAM, the receiver appointed by the Virginia State Courts;

Judge BOND announced that an order would be issued directing the receiver appointed by him to settle his accounts on or before a day to be fixed; whereupon he will be discharged and the parties will be allowed to proceed in the State courts, according to the desire of a large majority of the creditors of each class.

It is stated that three-fourths of all the creditors of the road favor the foreclosures of the mortgages and settlement of the affairs by the State courts.

The earnings of this road for the year ending Sept. 30 were $1,459,189 48, and the expenses $1,112,320 70. In addition to the above sum of $1,112,320 70, there was charged during the year 1874-5, to transportation expenses, $23,033 78, which belonged to previous years.

The Maryland Coal Company, has declared a dividend of $1 50 per share out of the profits of the year 1875, payable on and after the 31st of January. This is equivalent to an annual dividend of over 8 per cent. on the present market value of the stock of this company.

The official return of the gross earnings and expenses of the St. Louis, Iron Mountain, and Southern Railway Company for the months of October and November 1875, exclusive of land sales, is as follows:

For October 1875, earnings of railroad	$388,603 75
Total operating and general expenses... ...	221,399 07
Net	$167,204 68
For November 1875, earnings of railroad ...	$429,765 07
Total operating and general expenses	218,964 33
Net	$210,800 74

The annual meeting of the stock holders of the Scotia Coal Company is announced for January 10th. A meeting of the stockholders of the West Fairmont and Marion Consolidated Gas Coal Company, was held on the 5th inst.

The Glendon Iron Company announces a dividend of 3 per cent. payable in Boston, January 1st.

The coupons of the first mortgage bonds of the Central Pacific Railroad Company, the Western Pacific Railroad Company, and the California and Oregon Railroad Company, due January 1, will be paid in gold at the offices of Messrs. FISK & HATCH, No. 5 Nassau street.

The total amount of interest and dividend disbursements in New York during the present month will aggregate nearly $48,000,000, and in Boston nearly $10,000,000.

Quotations and Sales of Stocks and Bonds,

For the week ending Jan. 7, 1875.

STOCKS.

	Highest	Lowest	Closing	Shares sold.
Pennsylvania Coal Co	—	—	†277½	—
Consolidation Coal Co	—	—	47	100
Spring Mt. Coal Co.....	—	—	63	50
American Coal Co.....	—	—	50	50
Maryland Coal Co.....	—	—	17¼	100
Del., Lack., and West. RR. Co.....	120¾	†117½	118¾	2074
New Jersey Central RR. Co.....	106¼	†103½	104	1430
Delaware and Hudson Canal Co...	124	124¼	124¼	291
Quicksilver Mining Co. pref'd.....	—	—	23¼	100
" " " Common..	—	—	18¼	100
Mariposa Land & Min. Co. various.	10¾	9¼	10⅜	200
St. Louis & Iron Mountain RR....	—	—	15	300
Lehigh & Wilkes-Barre Coal Co....	—	—	49	—
Total Shares sold				4795
Sales for the week previous				4704
Increase.....				91

† Ex. Dividend.

BONDS.

	Sales.	Price	
Ches & O. R. R. 6s, 1st. cou. on...	19,000	28	@ 33
" " " ex coupon	3,000	—	@ 25
Central RR. of N. J. 1st Mtg. N..	—	—	@115½
" " " 1st Cons.....	1.000	—	@109
" " " Convt.	16,000	—	106¼@107
Del. and H. Canal, 1st Mtg. 8s'...	—	—	@112
" " '78, '94... ...	15,000	—	@109¼
" " Reg. '91	15,000	—	@111½
Del., Lack. & W. R. R., 7s, conv..	—	—	@124
" " " " 2d Mtg..	3,000	—	@115
St. Louis & Iron Mount'n 1st Mtg	2,000	95	@ 96
St. Louis & Iron M'tn, 2d Mtg.	—	—	@ 51†
Lehigh & Wilkes-Barre Cons.....	12,000	—	@ 96
Total Sales.....	$86,000		

Closing quotations, in the absence of sales, represent the latest prices bid.

† Asked.

Philadelphia Stocks.

PHILADELPHIA, Jan. 7, 1875.

The feature of the week, in the Philadelphia Stock Market, has been the advance in the stock of the Pennsylvania RR. Sales for the week have amounted to some 36,000 shares; the stock closing strong at 53⅛, an advance of over one per cent. from the highest quotation recorded in our last. Reading RR. closed firm at 54⅛, ex-dividend with transactions amounting to some 5000 shares. Lehigh Coal and Navigation Company has been fairly active during the week, closing at slightly advanced figures. Transactions in bonds have been unusually large, the sales aggregating nearly $160,000; the dealings being pretty evenly distributed throughout the list, with prices, in the majority of instances, realizing advanced rates.

We note the following sales at auction: 311 Cambria Iron, 16½; 30 Westmoreland Coal, 85; 40 Allentown Iron Co., at 50; $21,000 Wilmington Coal M'g. Co., 1st cou. 7s, at 93; $4000 Tremont Coal Co., 1st cou. 7s, 92½-93; $12,000 Philadelphia & Reading, conv't. cou. 7s, 105¼.

The following annual meetings are announced: Rockhill Iron & Coal Co., Jan 10; East B. T. RR. & Coal Co., Jan. 10; P. & N. Y. Canal & RR. Co., Jan. 10.

The Little Schuylkill RR. & Coal Co. announces a semi-annual dividend of 3½ per cent., payable on demand. The Minehill RR. Co. announces a semi-annual dividend of 3½ per cent., payable on demand. The Buck Mountain Coal Co. the Fulton Coal Co., the Nescopec Coal Co., and the Emaus Iron Co. all have quarterly dividend periods, during the present month. The coupons on the mortgage bonds of the Susquehanna Coal Co., due Jan. 1st, will be paid on presentation on and after the 3d inst.

It is reported that the Philadelphia & Reading Coal & Iron Co. have succeeded in negotiating a loan of $10,000,000 in London.

Quotations and Sales of Stocks and Bonds,

For the week ending Jan. 7, 1876.

STOCKS.

	Highest	Lowest	Closing	Shr's
Lehigh Valley RR. Co	62¼	62	62	436
Pennsylvania RR.	54	52¼	53⅝	36050
Reading RR.	55⅞	54¼	54¼†	5000
Lehigh Coal and Nav. Co	50½	49⅞	50⅛	3982
Penn. Canal	—	—	9	—
Buck Mountain Coal Co.	—	—	—	—
Fulton Coal Co.	—	—	3½	—
Locust Mountain Coal Co	—	—	—	—
Westmoreland Coal Co.	—	—	80	—
St. Nicholas Coal Co.	—	—	1	—
Cambria Iron Co.	—	—	16⅜	100
Crane Iron Co.	—	—	46	—
Emaus Iron Co	—	—	—	—
Pennsylvania Salt Manufact. Co.	—	—	76	88

Total shares sold 46,256
Sales for the week previous 37,225
Increase 9,031

† Ex Dividend.

BONDS.

	Sales.	Price
H. and B. T. RR. 1st mortgage, 78	—	— @107
" " " 2d "	—	— @104¼
" " " 3d " cons	2,000	— @ 53
Lehigh Valley RR. Con. mtg. 68, Reg	1?,000	— @ 97½
" " 78, 1910	2,000	— @111½
" " 6s reg. and cou.	12,000	104 @106¼
Pennsylvania RR., 1st mtge. 68	2,000	— @103†
" gen. " cou. 1910	17,000	‡100⅛@103½
" " gen. " 68, reg.	15 000	102½@103
" " Cons. M. 6s Reg.	10,000	— @ 95¼
Phil. & Reading RR. 78 '93	2,000	— @103½
" " " G. M. 78, cou. 1911,	16,000	— @106½
" " " " Deb. 68	—	— @ 80
" " new convertible 78	50,800	105† @105½
Phil. & Reading C. & I. Co. 78 deb.	—	— @ 83½
Lehigh Coal & Nav. Co., 6s '84	500	— @103
" " " RR., '97	500	— @104
" " " Con. m. 78	—	— @107
" " " Convt. gold, '97	19,000	103 @103½
Penn. Canal, 6s	—	— @ 72½
Penn. and N. Y. Canal, 78	1,000	— @107
Ches. and Del. Canal, 6s	—	— @ 88
Susquehanna Coal Co. 78	—	— @ 70
Buck. Mount Coal Co. 6s	—	— @ 97½
Penn. Gas Coal Co. 6s	—	— @100¼

Total amount of sales $159,800

Closing quotations, in the absence of sales, represent the latest prices bid.

† Ex. Interest. ‡ Ex Coupon.

Gold and Silver Stocks.

NEW YORK, Jan. 7, 1876.

A decline of $3 per share in Raymond and Ely is the only exception to a still further advance in San Francisco Mining shares. Consolidated Virginia is up to $431 per share, an advance of $28 on our last quotations. The ore product of this company for the last week in the year was 4,082 tons; the regular monthly dividend of $10 per share has been declared, payable on the 11th inst., which will amount to a total dividend disbursement by this company of $13,040,000, to the close of 1875. California has advanced $5 per share, its present quotation being $80 per share. This mine will be connected with the Ophir by a drift on the 1,500 foot level, which is partially finished. The ore at this point is reported to be of poor quality. The present market value of the two mines above amounts to nearly $90,000,000; this amount is equal in value to 6,198,347 lb. Troy, of pure silver.

The following dividends have been declared payable during the month of December: Empire Mining Company, $5 per share, aggregating $5,000; Northern Belle Mining Company, $1 per share, aggregating $50,000; West Comstock Mining Company 50c. per share, aggregating $50,000 and the Giant Powder Company, 14 per cent, amounting to $9,000. Assessments with dates when delinquent: Meadow Valley Mining Company, 50c. per share, February 10th; Savage Mining Company, $1 per share, January 19th; Succor Mill & Mining Company, 50c. per share, January 29th; Daney Gold & Silver Mining Company, 50c. per share, January 25th; Alhambra Quicksilver Mining Company, 5c. per share; Dexter Silver Mining Company, 20c. per share, January 24th; Red Jacket Mining Company, (Idaho) 25c. per share, January 20th; Silver West Consolidated Mining Company, 10c. per share, January 20th.

QUOTATIONS:

	No. of shares.	Dec. 29.	Jan. 5, PM.
Sierra Nevada	100,000	21	$23
Union Consolidated	100,000	7	10
Mexican.	108,000	20	20
Ophir	108,000	54	59
California	540,000	75	80
Consolidated Virginia	108,000	403	431
Best & Belcher	100,800	58	61
Gould & Curry	108,000	19	20
Savage	112,000	17	21
Hale and Norcross	16,000	45	52
Chollar Potosi	28,000	94	108
Alpha Consolidated	30,000	21	23
Imperial	100,000	10	10
Yellow Jacket	24,000	106	116
Kentuck	30 000	13	14
Crown Point	100,000	28	28
Belcher	104,000	33	35
Overman	38,400	60	66
Caledonia	20 000	21	24
Justice	105,000	26	30
Raymond & Ely	30,000	20	17
Meadow Valley	60,000	1	3
Eureka Consolidated	50,000	16	16
Eureka G. Y.	25,000	3	3

Copper Stocks.

Specially reported by Messrs. WILSON W. FAY & Co., Bankers and Brokers, room 7 Traveller Building, 31 State street, Boston.

BOSTON, WEDNESDAY EVENING, Jan. 7, 1875.

The week closes with a better outlook for coppers. There is stronger feeling on all the stocks throughout the list. Allouez is strong at $20 bid, and the stock is commanding considerable attention. Calumet has made a notable advance to 168, closing that bid. Duncan silver is very steady at 1¼ to 1⅝. There is very little inclination to trade in the small coppers, the parties that are in can't get out, and the parties out don't care to get in. Franklin is a little firmer at 14, and if reports are true, will be on the dividend list again before long. Eastern RR. steady, 9¼, 9½.

Description.	Par Value.	No. of Shares	Closing. Bid.	Closing. Asked.
Allouez	$50	20 000	$ 20¼	$20¼
Calumet and Hecla	20	80,000	163	168¾
Central	25	20,000	34	34 50
Copper Falls	25	20,000	5¼	5¾
Dana	25	20,000	15	18
Duncan Silver	20	60,000	1 25	1⅜
Franklin	25	20,000	13¼	14
Humboldt‡	25	20,000	25	30
Madisca	25	20,000	25	30
Mesnard	25	20,000	57	⅝
Minnesota	25	20,000	2 00	2¼
National	15	20,000	2	2¼
Petherick	25	20,000	55	60
Pewabic	25	20,000	5⅛	5⅜
Phenix	25	20,000		
Quincy	25	20,000	44 00	44 50
Ridge	25	20,000	⅝	⅞
Rockland	25	20,000	35	40
International Silver	—	—	10	15
Star	25	20,000	25	30
Superior	25	20,000	⅛	⅛
Eastern RR.			9¼	9½

Gas Stocks.

NEW YORK, Jan. 7, 1875.

Quotations of gas stocks are steady and the market is fairly active. Brooklyn stocks are dull and quiet. We note dividends payable during the present month as follows: Providence, R. I., Gas Co., $2.50 per share, payable on demand; Haverill, Mass., Gas Co., 4 per cent.; Brookline, Mass., Gas Co., 4 per cent., due Jan. 15th; East Boston Gas Co., 5 per cent., due Jan. 15th; San Francisco, Cal., Gas Co., 2 per cent. (monthly). The Northern Liberties Gas Co., of Philadelphia, will pay a dividend during the month. The Peoples Gas Co., of Baltimore, have declared a dividend of 3 per cent. payable on and after Jan. 3rd, Sales of stocks which we quote, aggregating over 1,000 shares, are reported to us for the week at prices within the limits of our quotations. Quotations of the bonds of the Mutual Gas Co., of Buffalo, N. Y., range from 80 to 90.

The following list of Companies in New York and vicinity are corrected weekly by GEORGE H PRENTISS, Broker and Dealer in Gas Stocks, No. 30 Broad st., N. Y.

Quotations "bid" and "asked" of New York City and Vicinity Gas Companies are on the $100 of stock and not on one share.

Companies in New York and Vicinity	Cap. Stk.	Par.	last Divid.	When Paid.	Bid.	Askd.
			pr.c			
Mutual, N. Y.	$5,000,000	$ 100	2½	Oct. '75	109	110†
" " Bonds	900,00	1,000	‡3½	Aug. "	105	107¼
NewYork, "	4,000,000		5	Nov. "	148	150†
Metropol. "	2,500,000	100	5	Sept. "	155	160
" " Certf.	1,000,000		3½		104	105
" " Bonds	500,000	1,000	3½	July, "	105	
Harlem "	1.850,000	50	4	Aug. "	135	140
Manhattan"	4,000,000	50	5	July, "	304	305
Brooklyn, B'klyn	2,000,000	25	5	Nov. "	238	240
Nassau "	1,000,000	20	4	July, "	121	126†
" " Certf.	700,000	1,000	3½	Nov. "	101	102†
People's "	1,600,000	10	3½	July, "	92	93¾†
" " Certf.	300,000	1,000	3½	July, "	95	100
" " Bds	325,000		3½	Aug. "	100	101
Metropol. "	1,000,000	10	3½	May, "	90	97
Wmsburgh "	1,000,000	50	5	July, "	150	155
" " Certf.	1,000,000		3½	July, "	100	101
Citizen's "	1,200,000	20	2½	Oct. "	122½	125†
" " Certf.	320,000	1,000	3½	Oct. "	100	101
J. C. & Hob'n. N. J.	386,000	20	5	July, "	160	170
Centl. Westch. N. Y.	466,000	50	4	July, "	100	105

‡ Gold. † Ex Dividend.

Companies out of Town.*	Cap. Stk.	Par	Bid	Askd.
People's " " of J. C.			130	
Citizen's G. L. Co., Newark, N. J.	1,000,000		60	70
Hempstead" " L. I., N. Y.	46,000	100		100
Jamaica, " " "	25 000	100		100
Richmond Co., S. I. "	300,000		100	105
Citizens', Rochester, "		100	60	68
Rochester Gas Co., "		100	50	
People's G. L. Co. Albany, "	1,000,000	100	31	40
Mutual " Buffalo "	750,000	100	55	60
Mutual " Detroit, Mich.		50	20¼	24
TroyG. L. Co., Troy, N. Y.			108	
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Baltimore G. L. Co., Balt., Md.	2,000,000	100		195
People's G. L. Co., Balt., Md	2,000,000	25	26½	
Hannibal G. L. Co., Hanni., Mo.	100,000	100	95	100
La Clede, Mo.				123
Lewiston G. L. Co., Lewis., Me	400,000	100		75
Chicago G. L. Co., Chicago, Ill.	2.000,000	100	140	
Jacksonville, Ill.	120,000	100	82	85
Lima, Ohio	60 000	100	10	
Derby G. L. Co., Derby, Conn.	160,000	100		80
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Fort Wayne G. L. Co. F. W., Ind		100		105
North. LibertiesG. L. Co. Phila.		25	29½	
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Chelsea G. L. Co, Chelsea, "	300,000		139	
Cambridge G. L. Co., Cam., "	700,000		132¾	
Louisville G. L. Co., Louis., Ky.			127	
Cincinnati G. L. Co, Cincin. O.				220
S. F. G. L. Co. San Francisco, Cal	10,000,000	100	92½	93
City G. L. Co. Montreal, Canada	1,440,000	40	138	139
Consumers G. L (old.)Tor., Ont	600,000	50	132	
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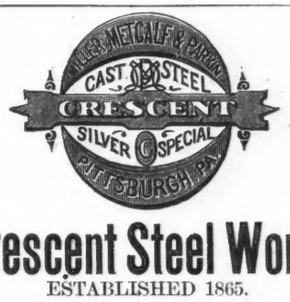

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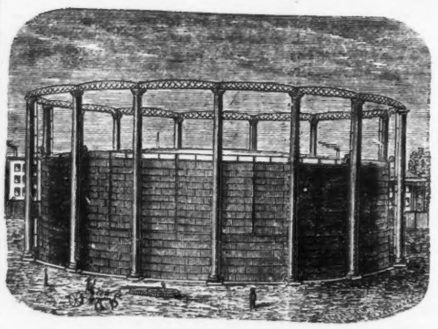

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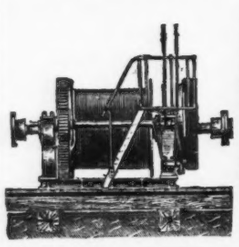

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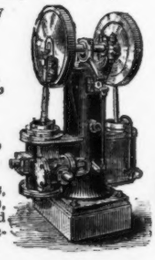

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CONTENTS.

EDITORIALS:
The Gold, Silver, Lead, and Copper Product of Utah Territory for 1875. 53
The Fryer Process 53
The Chicago Silver Mining Co. 54
New Publications 54
Bicheroux's Gas Furnace 55
Wear of Wire Rope 56
Iron-making Experiments in India 56
Price of Iron in Ohio from 1858 to 1875, Before, During, and Since the War 56
On the Use of Pulverized Fuel 57
The Velocity of Blast Furnace Gas 58
The Ophir Mine, Nevada 59
Illuminating Gas 60
CORRESPONDENCE:
Colorado 61
Strains in Trusses 61
Accidents in the Utica Gas Works 62
Difficulties of Silver Mining in Mexico 62
Notes 56, 62
Selected List of Patents 62
STATISTICS OF COAL PRODUCTION 62
COAL TRADE REVIEW 62
Iron Market Review 65
FINANCIAL:
New York Stocks 66
Metals 66
Philadelphia Stocks 66
Gold and Silver Stocks 66
Copper Stocks 67
Gas Stocks 67
Advertisements 67

The Gold, Silver, Lead, and Copper Product of Utah Territory for 1875.

OUR correspondent in Salt Lake City, Utah, who has taken great pains to collect the exact figures in regard to the product of Utah during 1875, sends us the following. We regret only, that we are unable at present to separate silver and lead, as well as silver and copper values correctly, but will do so hereafter.

Base bullion (argentiferous lead) 16,330 tons, at $250 cur'y.	$4,082,500
Silver bars, value,	637,763
Gold dust,	35,800
Silver—Lead ores, 5,312 tons at $50,	26,560
349 tons Copper bullion at $100,	34,900
284 tons Copper ore at $40,	11,360
Total, currency,	$4,828,883

The Fryer Process.

A GOOD deal of interest has been excited in California by the advent of a new process for treating gold and silver ores, invented by Mr. ROBERT M. FRYER, of New York, and operated in works erected in Nevada County, California. The newspapers have brought out their stereotyped paragraphs about the extraordinary yield of refractory ores under this new treatment—and the ENGINEERING AND MINING JOURNAL has maintained silence on the subject, for the simple reason that the details of the great discovery were kept secret, and we have found it a good rule to decline to discuss inventions involving this feature. One thing the process possessed, which seemed to cause the greatest enthusiasm concerning it. Its proprietors were not begging for capital, but entered the field, asking odds of nobody, and erected their works. If they had begun to sell interests in the great invention, or if they should now begin to do so, before throwing it open to the public scrutiny of experts and business men, the inference would be highly unfavorable. We trust this is not the significance of the circumstances indicated in recent exchanges, from which it appears that a select party, including some editors, have been allowed to see the whole thing, and, although they cannot yet make known the secrets, they are thoroughly delighted, and can assure the public that a metallurgical millennium is at hand. From the vague intimations of the editors aforesaid, we infer that the process, so far as the gold ores of Grass Valley and Nevada City are concerned, is that of roasting and amalgamation; and that all the apparatus is novel. The roasting-furnace is new; the crusher is new; the amalgamator is new; etc. In addition to these indefinite statements, we have before us the specification of Mr. FRYER, forming part of Letters Patent No. 170,625, dated Nov. 30, 1875, for an improvement in apparatus for roasting gold and silver ores.

The idea of roasting gold ores before amalgamation is a reasonable one. It follows the analogy of nature; experience having shown that auriferous sulphurets yield considerably more by amalgamation after undergoing slow oxidation by simple exposure. Unfortunately, most attempts to effect such oxidation artificially have resulted in leaving the gold in such a condition that it will not readily amalgamate. Of these failures, undoubtedly the greatest part have been the experiments of persons perfectly ignorant of the principles of roasting, and hence have illustrated the folly of amateur metallurgists, and nothing more. But, in some cases, to our personal knowledge, skillful metallurgists have tried simple roasting without success. Mr. BRÜCKNER found this to be the case in his cylinders at Central, Colorado; but he also found that, by the addition of salt at the close of the process, he obtained (in the treatment of one lot of auriferous sulphurets) bright, amalgamable gold. The Gerstenhöfer and Stetefeldt furnaces have been hopefully regarded by experts as perhaps destined to a successful application for this purpose; but, so far as we are aware, no really successful working results in this particular line are on record from either of them. BRÜCKNER's experiment was never followed further—a practical difficulty of a different kind, increasing the expense of treatment, being caused in that case by the presence of copper-chlorides; and thus the matter stands. The fact is, that after a *thorough* roasting of auriferous ores has been accomplished, the nex step is chlorination, rather than amalgamation. The only chance for the latter in economical competition, lies in its possible application after a cheaper and less careful and complete roasting than chlorination requires.

Two things must be especially borne in mind. The first is, that almost any treatment of sulphurets will increase their yield of gold by subsequent amalgamation. Mere neglect and time will decompose them more or less, so that something more than the original yield of fine gold can be caught. Hence the popular test of comparison, namely, with the ordinary yield of battery-amalgamation, turns out favorably for all inventors of processes; which the stern economical test, comparing the extra yield with the extra cost, usually results unfavorably.

In the second place, the chief trouble with all the gold ores in the world is that they are poor! Samples sent for experimental treatment, even when honestly selected—that is, not intentionally picked out to represent only the richest parts of the vein—are almost invariably better than the average of the whole vein-matter. Even the stamp-mill does not receive, in the majority of cases, the whole of the material extracted. A large proportion of the immense waste-dumps at our gold mines is not wall-rock, but rejected ore, too poor to bear the expense of further treatment. Now an increase in the expense of reduction, though it be attended by an increase in the percentage of yield, may leave untouched the great mass of ore, and give no real gain of net profit from mining The stamp-mill process, employed under favorable conditions (such as cheap fuel, light hauling, etc.), permits the handling of vast quantities of low-grade material; and until something else offers to do that, the stamp-mill is not likely to be superseded. Moreover, in estimating costs, it is not safe to compare the experimental results of a new process with the well-ascertained expenses of a stamp-mill, regularly running.

To return to Mr. FRYER's roasting-apparatus; we have said that the idea it self is reasonable, and we add that in his patent, Mr. FRYER describes his invention as intended to roast gold and silver ores cheaply and rapidly, to expel sulphur, etc., without the loss of the precious metals by volatilization and absorption. The first part of this proposition expresses just what is wanted. The latter is, so far as gold is concerned, not far from nonsense. Mr. FRYER's furnace is suspended, so as to leave free the bottom, which consists of a double metallic tub, cooled between the casings with water, as is also the whole furnace. This tub stands on wheels, and can be run in on a track, and lifted upon a hoist-table, so as to embrace the bottom of the furnace. After the operation is complete, the tub can be lowered and removed, carrying with it the roasted quartz. This seems to be the only feature of the apparatus intended to secure cheapness and rapidity. At the top, the furnace ends in a conical cover, suspended over, but not fitting to, the throat. The products of combustion escapes through the annular space under the edge of this cover, over which a sheet of water is continually flowing (after high temperature has set in); and thus the gases, vapors, etc., pass through a thin shower of falling water, after which what is not condensed goes on up the stack. In this there is a steam-blower, supplied with steam from the water in the furnace-casings, which makes a strong draft, to counteract the deadening effect of the spray through which the vapors pass. This spray falls subsequently into a small annular chamber surrounding the upper part of the furnace, where it deposits its solid contents and escapes, through an overflow-pipe, to any desired reservoir. The operation, according to Mr. FRYER, is as follows: fuel and quartz are placed in the furnace, and the former is ignited. Steam is soon generated, and the blower set in operation, when the draft is greatly increased. When the heat becomes very intense, water is applied to the cone. The result of the charge is that some of the precious metals are collected in the upper chamber, while the greater portion is delivered at the bottom, or car, with desulphurized quartz. The car is then lowered, to clear the bottom of the furnace, and then run along the track to a proper delivery, where the material is deposited for further treatment. The car is returned to its original position, when the furnace is again ready for operation.

Without any further light than is given by this patent, which may, perhaps, be an imperfect description, we are constrained to say that we think Mr. FRYER will find great difficulty in effecting a satisfactory roasting in this apparatus. It is merely a kiln, in which the fuel and ore are in contact, and, in which, according to his own avowal, a very high temperature is produced by the agency of a strong draft. In other words, it is not far from a cupola furnace, and it is better adapted to melting than to roasting. As for his upstairs annular chamber, it seems likely to catch plenty of flue-dust, to receive which, by the way, it is too small and inconvenient; and as for his trundle-bottom, it seems likely to catch a pretty mess of slag, matter, cinders, and ashes, the "further treatment" of which will remind the unfortunate operator of that man whose last state was worse than the first. We do not pronounce this process, on such insufficient evidence, a swindle; but we do say that if Mr. FRYER's patent correctly describes Mr. FRYER's plan, he would have been greatly the gainer, if, instead of conducting his preliminary experiments with secrecy, he had admitted to his confidence some one familiar with elementary metallurgy, or even (if he could not trust living persons) a copy of PLATTNER's *Röstprozesse*.

In treating such ores as are produced in the neighborhood of Grass Valley, consisting chiefly of quartz with a small percentage of sulphurets, the melting and matting of the charge may not prove so troublesome as to be utterly fatal. On massive or nearly massive sulphurets, this furnace could not be used at all. But even in roasting quartz with a small percentage of sulphurets, we do not see how the Fryer furnace is to work more cheaply and rapidly than a common kiln, especially as it is not continuous in its operation, which the roasting kilns of to-day are. Like any other kiln, it would be unable to roast tailings or concentrated ores in fine particles; and for treating lumps of quartz, con-

taining a small percentage of sulphurets, it presents several items of extra expense as compared with a common kiln. It is more costly to construct, with its double walls, metallic castings, etc. It requires more fuel, because heat is consumed in making steam for the blower, as well as by the general system of water-cooling. And these expenses are wholly unnecessary, being based on the desire of getting a draft and maintaining a high temperature, whereas a high temperature is emphatically what is not wanted. We have, therefore, as the sole remaining chance of economical gain, the movable trundle-bottom, to get which, the whole furnace is "suspended." But how much better is that than the ordinary way of running a car under the grate-bars of a kiln, and dumping the charge into the car? We pause for a reply. *

The Chicago Silver Mining Company.

THIS company, whose headquarters are in London, held a meeting on Dec. 22d, at which the annual report was read. From it we summarize the following:

From June, 1874, to June, 1875, the company smelted, at its works on Rush Lake, Utah, 3,418 tons of Chicago, and 7,196 tons of bought ore, the profits of which amounted to £11,557, as against £9,405 for the previous fifteen months. Payments on account of dividends of 4s. per share, or at the rate of 8 per cent. per annum, were made quarterly in October, 1874, January and May, 1875, and in August a similar amount would have been paid, had it not been resolved to apply the accumulating profits to the purchase of the Flavilla and Queen of Hills Mines. These mines were, after protracted negotiations, bought by Mr. GODBE, the company's manager, for $138,750, and the purchase has turned out to the entire satisfaction of the company. Early in August the company came into full possession, having held possession of half of these mines since the end of June. The profits, which before that time had reached an average of $6,000 per month, rose then to $13,000 in July, $20,000 in August, the same in September, and 21,000 in October. The whole cost of the new mines could thus be paid off on the 19th of October, and at the end of the month a remittance of £2,600 could be made besides. Another remittance of £2,650 was announced by telegraph on December 4th.

The condition of the company's mines (Chicago, Flavilla, and Queen of the Hills,) at the date of the report, was highly flattering, but by some recent explorations of the Hidden Treasure mine, which met those of the Chicago, a perhaps protracted law-suit is threatened.

NEW PUBLICATIONS.

SECOND GEOLOGICAL SURVEY OF PENNSYLVANIA (1874). Harrisburgh, (1875).

VOL. B. *Preliminary Report on the Mineralogy of Pennsylvania, by* F. A. GENTH. *With an Appendix on the Hydrocarbon Compounds, by* SAMUEL SADTLER.

VOL. D. *Report of Progress on the Brown Hematite Ranges of Lehigh County, with a Description of the Mines lying between Emaus, Albertis and Fogelsville.* By FREDERICK PRIME, JR., *Assistant Geologist.*

VOL. J. *Special Report on the Petroleum of Pennsylvania, its Production, Transportation, Manufacture and Statistics.* By HENRY E. WRIGLEY, *with Maps and Illustrations. To which are added, a Map and Profile of a Line of Levels through Butler, Armstrong, and Clarion Counties, by* D. JONES LUCAS; *and also, a Map and Profile of a Line of Levels along Slippery Rock Creek.* By J. P. LESLEY.

The arguments by which the Legislature of Pennsylvania was induced to re-organize a geological survey have been abundantly justified by the work thus far accomplished, and the publications which have been made. Not even the most obstinate Gradgrind of the State can object that its material interests have been neglected or postponed, while preparations for elaborate scientific work have been prosecuted. We are quite convinced that in the hands of Prof. LESLEY the thorough and permanent labors of the survey, topographical, lithological, palæontological, and chemical, will not suffer; we are glad that the reasonable demands of the people for practical help and light, while these labors are progressing, is so frankly recognized. The three volumes before us may not be all that have appeared; but they have lain for some time in our sanctum, awaiting notice; and they may serve us conveniently as a text for our remarks upon the whole survey.

The plan of their publication, as separate treatises, published and sold at a low price by the State, is worthy of praise, since it enables everybody who wants one or more of them to obtain cheaply and conveniently just what he requires. In view of this advantage, we cannot severely criticise the occasional coarseness of the photo-zinc plates—some of which, by the way, are notably better than others, by reason partly of the variable excellence of the original drawings, partly of the uncertainty which seems to effect the process of photo-zincography employed. The books are printed in clear and handsome type. The proof-reading is unequal: probably the authors have read their own proof, without first-rate professional aid—a system which never did, and never will, produce a mechanically perfect book.

Aside from these small blemishes, we can heartily praise the volumes. Dr. GENTH's preliminary report on the mineralogy of the State is calculated to stimulate and guide the zeal of amateurs and students; and no other one thing is half so likely to lead to discoveries of commercial importance as the cultivation among the people of the study of mineralogy, and particularly of collecting and classifying minerals.

Aside from the important questions relating to the anthracite coal basins, which are too complicated to permit a rapid treatment, there are no topics of greater practical importance to Pennsylvania than those which the reports of Messrs. PRIME and WRIGLEY treat. The nature and extent of the brown hematite ore ranges of the Great Valley are vitally related to the Lehigh iron industry; and the supply of petroleum is a matter which concerns the civilized world.

Prof. PRIME'S report is but a small portion of the thorough discussion which the brown hematite deposits are to receive from the geologists of the survey. It contains a brief sketch of the topography and geology of the district; notes on a large number of mines, with analyses of numerous samples of ore; descriptions of the methods of mining and washing, with one or two drawings of machinery; and a map with 10-foot contour lines, showing the topography of the district, and the locations of nearly a hundred ore-banks and mines. This map is accompanied with a note, principally geological, by Prof. LESLEY himself. On this disputed question of the origin of these deposits—whether by oxidation of iron pyrites, or by alteration of carbonate of iron, or by reactions between limestone and ferrous sulphate—Prof. PRIME does not commit himself. As to their age, he says they occur in formation No II. of Rogers, corresponding to the calcifrous sandrock and Chazy limestone of the New York geologists, and to the magnesian limestone and saccharoidal sandstone of Missouri—in other words, the Lower Silurian rocks immediately overlying the Potsdam sandstone. In one passage (p. 3), Prof. PRIME says these rocks "are, for the most part, massive semi-crystaline and compact dolomites (magnesian limestones) separated by one or more beds of damourite slate intercalated between them." In another passage (p. 14), he says, "from the examinations thus far made, it is highly probable that the damourite slate is Roger's Upper Primal Slate, to which he assigns a place between the Potsdam sandstone and the magnesian limestone. At present the geological position of the slate along the base of the mountain is somewhat a matter of doubt; as at one point it has been found intercalated between limestones." This damourite or hydro-mica slate is the matrix of the brown hematite ores—or rather, it underlies these ores and carries them in its upper layers. Prof. PRIME conjectures it to have acted as an impervious bed to the waters containing iron in solution, causing them to deposit oxide of iron in and upon the slate. The damourite slate is usually yellowish-white to pale straw-yellow or pink, with pearly luster when freshly exposed. It decomposes easily (losing alkalies), and is converted into a soft, unctuous clay, which is generally brown or yellow at first, but in time becomes white by breaking. As frequently happens, the practical explorers for brown hematite ores recognized the connection between the slate and clay, on one hand, and the ore on the other, before it was studied by scientific observers. They noticed also that in some mines the ore lies upon the dolomite, in pockets, less extensive and reliable as a basis for mining. But the previous accumulation of such facts emphasizes, instead of removing, the necessity of a thorough study of them. The field is ripe for a harvest of science, which, collecting, winnowing, and utilizing the data of practice, shall give us back our empiric knowledge in forms of greater value. We think the beginning made by the survey promises well for an exhaustive and complete elucidation of the subject, which will be a guide to the practical miner and the owner of land. By all means, the work should go on, as it has begun, until the whole story shall have been read and interpreted.

With regard to the petroleum deposits of Pennsylvania, the report of Mr. WRIGLEY is most timely. When petroleum was first obtained in considerable quantities, the universal and very natural expectation was, that the oil-bearing territory would be soon exhausted. Now, the production exceeds the demand; prices are unprofitably low; and the popular impression is that the supply is inexhaustible. Meanwhile, new applications are daily invented and introduced; petroleum is coming into use in gas-making and metallurgy; and if the supply should really prove limited, its failure may take by surprise a hundred industries, based upon its cheap and unlimited production. It is certainly high time that, by the most thorough collection and discussion of facts that can possibly be made, the question should be measurably settled.

Such a discussion Mr. WRIGLEY'S report does not pretend to furnish. It is but preliminary—and we find much reason to regret, in reading it, that it was not undertaken years ago. It is very late for a preliminary report on petroleum; and, unless the inquiry is now vigorously and unremittingly followed up, there is danger that, for Pennsylvania at least, the final report may come only when irretrievable waste has ruined a great industry. Mr. WRIGLEY says (p. 77):

"The special difference between the mining of coal and other solid minerals, and of this fluid, lies mainly in the fact that the former is not necessarily wasteful. The bed can be measured and estimated; and we know that we can go and get it when we want it, and stop when we please. We know also that operations on the land of one owner may be carried directly to his boundary line without affecting the interests of his neighbor. But the oil sand-rocks which stretch under adjoining farms are not only affected but often absolutely controlled by a few thoughtless operators, who own or lease territory adjoining that in which a good well has been found. Developing a bed of rock is but a race betweed the owners of the surface above it, as to who shall first exhaust the basin of oil below the surface, common to all parties. All this is highly disastrous; and the result has been, that whereas we know that a sand-rock, if kept free from the surface water and pierced by only a moderate number of holes, will last eight or ten years, the average life of a well has not practically reached three years. * * * * Had it been possible from the start to regulate drilling, it can hardly be questioned that one-third of the wells that have

been drilled would have brought as great a return as we have had from them all thus far, and at one-third of the cost of production,

Mr. WRIGLEY divides his report into four chapters, treating respectively of its historical, geographical, geological and economical aspects. The style and substance of each are in the main highly satisfactory. A vast array of facts is marshaled with skill. We note an occasional literary blunder, like the following paragraph about the gentleman who bored the first oil-well:

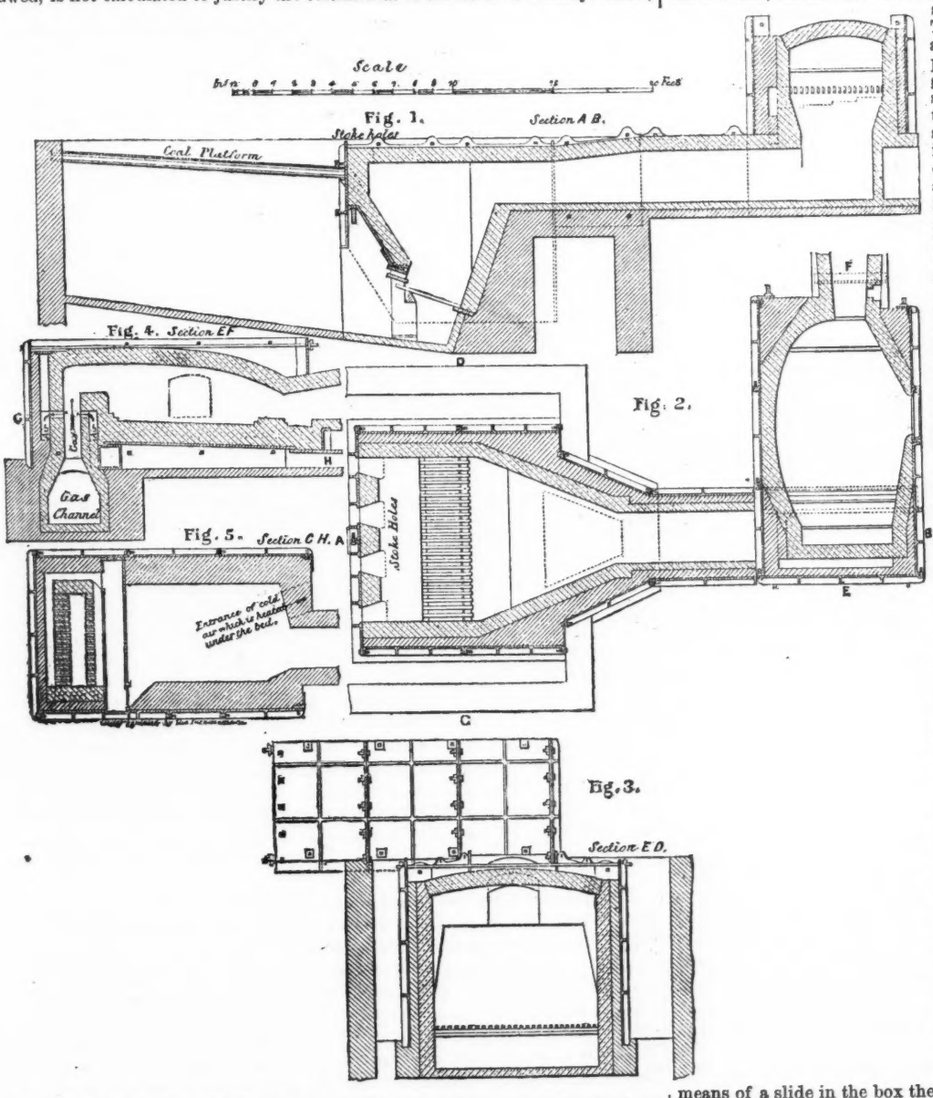
"For this purpose they engaged Mr. E. L. DRAKE, of New Haven, Connecticut, who seems to have had, as a sole recommendation, that quiet patience and perseverance which doggedly pursues its object, unmoved by present difficulties, or the prospective results of future success or failure. His mission on earth, however, seems to have been accomplished by the sinking of this first well for oil, so much so, that he appears to have dropped out of sight soon afterward, as far as oil was concerned. It was not, however, for want of either ability or courage that he should do so, but perhaps awed by the flood of industry and commerce that, swelling with each successive year, has poured a stream of wealth from our State—by his first small rift in the rock—he felt that his work was complete; and the careful observer will, no doubt, fully concur in the belief that the testimonial of the State of Pennsylvania, in recognition of his services, was an act of simple justice, well deserved, to a man whose fame was well-earned."

This confused representation of Mr. DRAKE as a man who had for a sole recommendation dogged perseverance, yet, after boring a well 71 feet deep, dropped out of sight, not for want of courage, but, perhaps, because he was awed, is not calculated to justify the testimonial of the State of Pennsylvania; nor is it a fit substitute for the paragraph which Mr. WRIGLEY could easily have written in the same space, telling what became of Mr. DRAKE, and what the State of Pennsylvania really did for him—points which have been repeatedly published, but ought not the less to have been made a part of this permanent record. The perusal of this passage, and one or two others in the report, might cause a reader, who should go no further, to distrust the ability of the author to compose a sensible and straightforward statement. But this conclusion would be incorrect. Mr. WRIGLEY "drops into" eloquence "in a friendly way" but very rarely; and when he is not eloquent, he is forcible and clear. We shall recur to his report at a future time, for the purpose of quoting some of its statistics and descriptions; and these quotations will impart to our readers the sincere opinion which we entertain of its value.

In conclusion, we repeat that we hope this survey will be earnestly supported by Pennsylvania. It has given already unusual proof of its usefulness; and what it will accomplish in the near future, if adequately maintained, will confer inestimable benefit upon both science and industry. *

Bicheroux's Gas Furnace.

WE give herewith engravings showing the construction of BICHEROUX'S gas furnace, an arrangement which has been for some time in extensive use on the Continent, especially in Westphalia (for instance, at the Rhenish Steel Works Company, in Ruhrort, at JACOBI and HANIEL'S works in Oberhausen, and at HARKOT'S works in Duisburg), in Belgium (at Ougrée, Séraing, Angleur), in France (Monceau, Ars-sur-Moselle), and in Austria at the Railway Works at Gratz. More recently BICHEROUX'S gas furnace has been introduced into England by Mr. C. HOLSTE, of 21 Great St. Helen's, London, E.C., and the first furnace on this system was started about twelve months ago at the well-known Round Oak Iron Works belonging to the Earl of Dudley. Another furnace was started at the same works about two months ago, and we understand that it has been decided upon to alter all the furnaces to this system. The accompanying views will show at once the principal features of BICHEROUX furnaces. The heating furnace is of the ordinary kind, but where the grate is usually placed, passages are built for the gas and air. The furnace is connected by means of a canal with the producer, the latter being of a very simple construction; it consists of two vertical side walls, and inclined front and back walls. The front slope is supported by a strong framing, the back slope by brick work. The whole is vaulted over with fire-bricks. At the bottom of this so formed chamber are the fire-bars, about 2 ft. 6 in. long; they can easily be taken out to enable the stoker to draw the clinkers from the producer. There are besides two folding doors for the ashpit, by means of which the air can be completely shut off, so as to stop the generation of gas. At the top in front are three or four stoke-holes, through which the producer is fed; these stokeholes are either closed by bricks or simply by small coal. Before the stokeholes is a platform for the stoker and a supply of coal. The producer may be placed entirely above ground, and then requires the side framing, as shown; or it may be placed underground, when the side framing may be replaced by brick walls. If the ground permit it, the producer should be placed underground, as it then does not stand in the way of the workmen. The distance of the producer from the furnace depends on the circumstances in each case; but in order that the gases may not be cooled on their way from the producer to the furnace, it is perhaps advisable to place them not too far apart. However, in cases where the producers have been placed about 70 ft. from the furnaces, the results have been as satisfactory as where they were close together.



The gas flue is built of firebricks, and may advantageously be placed underground, when the framing may be dispensed with. This flue is sometimes provided with a slide valve of brick or iron, to shut off the gas when required; sometimes the valve is placed in the furnace, a little under the holes for the air; sometimes there is no valve, as in our engraving. The consumption of coal in the generator may, as we have said, be stopped by closing the doors of the ashpit, and making them air-tight by means of clay.

The furnace itself is, as already stated, the ordinary one, only in place of the firegrate passages are built for the admission of gas and air. The gas passage is the continuation of the flue coming from the producer, the gas entering the furnace over the bridge. Before it passes the bridge, however, it is met by a number of air-currents at one or both sides. The air passes from the flue at the sides of the gas passage into the latter through a number of small holes, formed by firebricks, placed a little apart from each other. The air thus admitted is previously heated, which may be done in various ways, either in the producer or gas flue, or at the bottom, or sides, or crown of the heating furnace. In our engraving it is shown as being done at the bottom of the furnace. The air enters at the end, opposite to the entrance of the gas, and travels slowly under the hearth-bottom (thereby keeping it cool and protecting it from rapid destruction) to a box of cast iron. From thence it enters the air passages at the sides of the gas passage. By means of a slide in the box the furnaceman can control the admission of air, and thereby the heat in the furnace, to a nicety. The ignited gas expands over the bridge into the furnace, where it heats the iron. Thence it goes under the boiler into the chimney.

The BICHEROUX gas furnaces share with other gas furnaces (SIEMENS, PONSARD, etc.) several advantages over the old furnaces worked with solid fuel. Amongst others the saving in fuel is considerable; at Round Oak, for instance, when working single shifts only, it amounts, we are informed, to 40 per cent. Another great advantage is that inferior coal may be used in the producer, which could not be used in the ordinary firing furnaces, while the combustion being perfect no smoke issues from the chimney and the control of the admission of air being so complete, the waste of iron is considerably reduced. The

ors, Messrs. BICHEROUX, state that at their plate works, in Duisburg, the waste for double-heated heavy boiler-plates amounts to 13 per cent., and in double-heated light ones to 15 per cent. For the same reason the fire-bricks of the furnace are better preserved, not being cut by the presence of superfluous air. The furnaceman also is enabled to concentrate all his energy on his proper work, the heating of iron, as the stoking is done by ordinary laborers. He can, therefore, heat more iron ; at Ougrée for instance, in furnaces where one class of iron tyres only is heated, it has been found that the old firing furnaces heated 10 tons per 12 hours, the BICHEROUX gas furnaces of the same size 14 tons in the same time.

In comparison with some other arrangements of gas furnaces, the BICHEROUX system has the advantage of being simple and easily applied to existing furnaces. while the working of the BICHEROUX furnaces does not differ from that of the old firing furnaces, the ordinary furnace man is therefore able to handle the BICHEROUX furnace in his usual way. The waste heat of the furnace in the SIEMENS and PONSARD systems is used for heating the regenerators, in BICHEROUX's system it is used for heating the boilers, which are usually attached to the heating furnaces. The waste heat from the furnace being so regular, the boilers and brick work are better preserved, not being subjected to variations in the temperature, and the combustion being complete, the flues require no cleaning, or very rarely.

The same system has also been advantageously applied to boilers, to reverberatory furnaces for smelting purposes, to furnaces for heating BESSEMER ingots, etc. It has also been applied to puddling furnaces, but aparently not with the same success, at all events not at all places. Whilst some manufacturers claim a complete success, others state that the results obtained are not better than at ordinary puddling furnaces. It is, therefore, not advisable to apply BICHEROUX's system to this class of furnace until greater experience has been gained with it.—*Engineering.*

Wear of Wire Rope.

THE directors of the Clay-street Hill Railroad, San Francisco, recently removed the old wire rope which has been in use for some two years and substituted a new one. The road runs up Clay-street Hill, and the cars are propelled by an endless wire rope passing up one side of the street and down the other, underground. The engine furnishing the power is at the upper end of the line. The old rope was 7,000 feet long, three inches in circumference, and made of 114 steel wires of No. 16 gauge. It was put in use August, 1873. It was made to work seventeen hours a day while running. During this time it carried 3,300,000 passengers.

A few deductions showing the amount of work obtained from this rope will be of interest. The 3,300,000 at an average of 150 pounds apiece would give 495,000,000 pounds. Eight cars go up twenty-five times a day for 840 days, giving 705,600,000 pounds. Adding the weight of the cars to passengers it gives 1,200,600,000, pounds, or 600,300 tons, raised 307 feet vertically in a distance of 3,300 feet in 840 days, working seventeen hours a day. The result is, we get 1,200,600,000 pounds raised 307 feet in 856,800 minutes. This rope traveled 64,263 miles, or more than equal to two-and-a-half times the distance around the globe.

While this rope was running it stretched about one per cent., or 70 feet on the 7,000. It was reduced in circumference about seven-thirty-seconds of an inch. The consumption of coal by the engine to perform this work was about 1,500 pounds of Wellington screenings per day, at $9 per ton. From experiments made at the station it was found that it took six pounds of steam to keep the rope running (unloaded) after it was started. It took twelve pounds to overcome the inertia and friction, The cylinder of the engine is twelve by twenty-four inches. The rope, was made by A. S. HALLIDIE, of San Francisco, from imported steel wire. The changing of the ropes took thirteen hours. The rope shows little signs of wear and would probably last a year or more longer with safety, but the directors thought best to take all precautions and change in time.

The new rope is 7,000 feet long and weighs 10,800 pounds. It is made of fine steel wire, hardened and tempered, No. 16 gauge. There are 114 steel wires and nineteen soft iron wires for the heart. The rope is three inches in circumference, and was made at HALLIDIE's factory, in this city.

As a matter of record we may also mention the data obtained for a rope in use at the Crown Point Mine on the Comstock. Mr. HALLIDIE has a statement up to the 6th of November. The steel rope was set at work August 1st, 1874, on the incline. The rope is 2,650 feet long, 6¼ inches in circumference and weighs 17,237 pounds. Up to the data mentioned it had worked 10,928 hours, and hoisted 209,592 tons. It runs at a speed of 670 feet per minute. Total weight of each lift 34,000 lb. ; vertical distance 1,500 feet in 10,928 hours. The rope is still at work and in good order. The record of these ropes speaks well for California manufacturers.—*Scientific Press.*

Iron-making Experiments in India.

A COMMUNICATION made by Mr. WALTER NESS to the South Staffordshire Mill and Forge Managers' Association details the experiments which, on behalf of the Government, he is conducting there, with a view to the utilizing, on the spot, of the coal and ironstone found about Warrorah. The ironstone is a magnetic variety ; and there are several hills, notably those at Lohara, where several million tons, capable of yielding from 60 to 70 per cent. of metallic iron, can be worked above the surface of the surrounding plain. A brown iron ore, capable of mixing, Mr. NESS obtained at Ruterapur, containing 49 per cent. of metallic iron. The limestone, similar in appearance to some of the mountain limestone of England, contains from 88 to 90 per cent. of carbonate of lime. The coal-seams are from 30 to 50 feet thick, and over 20,000,000 tons have been already proved. It occupies geologically an intermediate position between lignite and true coal, and with a little extra firing in an open grate generates steam well, though the quantity of ash is double that of the English or Welsh coals. Thus the coal is not a bad article, the ironstones and limestones are rich and easily obtained ; and all are abundant. Designing first to make iron of the Bessemer quality, and then to run it into ingot moulds for Bessemer steel rails, Mr. NESS describes how he erected a blast-furnace with the necessary blowing-engine and the usual apparatus for the heating of the blast, and to what stage the experiments have been brought. The furnace being 24 feet high, is about half the height of the ordinary blast-furnace of South Staffordshire ; and, excepting the hearth, all the parts of the furnace have been reduced in a like proportion. The furnace was assisted by the use of one-eighth part of charcoal in the charge. After much and careful blowing, during which the temperature of the blast was increased till the fire-bricks of the hearth were melted, Mr. NESS found it impossible to liquefy the iron. The contents were found to have assumed a consistency similar to that of an unshingled puddled bull. This raw metallic mass can be worked in a smith's forge without any great difficulty. Mr. NESS attributes his want of success, up to this date, to the weakness of coal, which decrepitated early upon its introduction to the furnace ; yet he succeeded by its use in making old castings boil in two hours in a small reverberatory furnace. Mr. NESS's views are that the ordinary blast-furnace method is not applicable to the Indian coal ; but he seems to believe in the practicability of one of the direct processes, such as Siemens' or Blair's, or by the injection into the furnace with the blast of gas generated in a Siemens' furnace.

Prices of Iron in Ohio from 1858 to 1875, Before, During, and Since the War.

THE following clear and well arranged table, which we take from the *American Manufacturer*, is from the books of an iron manufacturing company of Ohio. It shows that the prices of to-day are the lowest since 1858.

Comparative invoice price per ton of the following articles, from August 1st, 1858, to August 1st, 1875, inclusive, as compiled from the balance sheets made out at the respective dates named :

DATE.	Bar iron.	Muck bar.	Pig iron	Wrought scrap.	Billets.	Faggots.
August 1, 1858	$ 64 25	$ 38 00	$24 00	$30 00	none.	$38 00
August 1, 1859	58 12	38 00	27 00	30 00	$45 00	none.
August 1, 1860	56 55	40 00	26 50	30 00	42 50	40 00
August 1, 1861	53 00	40 00	23 00	30 00	42 50	40 00
	*57 98	*39 00	*25 12	*30 00	*43 33	*39 33
August 15, 1862	59 65	none.	32 00	30 00	50 00	40 00
August 7, 1863	83 75	61 60	none.	40 00	none.	61 00
Sept. 1, 1864	170 00	100 00	78 00	70 00	125 00	none.
March 1, 1865	135 00	90 00	68 00	60 00	110 00	none.
	†112 10	†83 87	†59 33	†50 00	†95 00	†50 80
August 19, 1865	95 00	none.	45 00	40 00	70 00	none.
March 1 1866	110 00	72 00	55 00	50 00	90 00	80 00
April 1, 1867	100 00	70 00	47 00	50 00	80 00	75 00
May 1, 1868	83 70	55 00	40 00	42 50	68 00	60 00
May 1, 1869	76 48	57 00	40 00	40 00	68 00	60 00
May 1, 1870	76 60	57 00	none.	37 50	65 50	60 00
June 1, 1871	76 00	55 00	35 00	35 00	65 00	60 00
August 1, 1872	‡100 00	‡75 00	‡45 00	‡45 00	‡75 00	‡75 00
August 1, 1873	71 50	50 00	35 00	38 00	58 00	58 00
August 1, 1874	55 00	40 00	none.	25 00	42 00	42 00
August 1, 1875	50 00	36 00	21 00	25 00	40 00	36 00

* Average of the four years immediately preceding the war, all years of specie payments.

† Averages of the four war years—specie payments suspended.

‡ Seven thousand miles of railroad were constructed this year.

Notes.

In the Peerless Mine, Horseshoe District, Park County, Colo., a very rich strike of ore is reported to have recently been made. The vein is composed of carbonates of lead, gray and yellow copper, and iron pyrites, and is twenty-one feet in width where last exposed. This mine is situated near the crest of Horseshoe Mountain, of the Mosquito range, and is accessible at all seasons of the year.

Condition of the Miners in Schuylkill County, Pa.—So far as the mining population of this county is concerned, we are happy in being able to report, truthfully, that it was never in better condition—never surrounded by more comforts—as a whole, than this winter. Since the first of July, every man and boy willing to work (and there have been few idlers) have been constantly employed at good wages. And never in the history of the county has such economy or frugality been displayed by this class of people. whom the city press delights to pronounce "the starving miners of Schuylkill County." Those who acted honorably and paid their store bills, contracted during the last suspension, are able to get credit again where it is needed, while those who did not pay their bills still have a considerable proportion of their earnings laid away for the necessities of the winter. This is the short and long story of all the suffering we read about in the city papers.—*Schuylkill Republican.*

The Destruction of Valley Lands by Mining Tailings is attracting the attention of the owners of property in the Yuba and Sutter Counties of California. At a recent meeting, at Yuba City, the following petition was prepared :

"To the Honorable the Senate and Assembly of the State of California, Twenty-First Session : We, the citizens, residents and taxpayers of the upper Sacramento Valley, of the State of California, do respectfully represent—

"That the system of hydraulic mining which is now, and for ten years last past has been, in progress on the western slope of the Sierra Nevada Mountains of said State, has had the direct effect of covering up to a depth of from one to fifteen feet nearly all of the rich bottom lands in said valley which are adjacent to the American River, Bear River, Feather River, Yuba River and Sacramento River, with an unproductive debris, to the damage of the actual settlers of said valley in the sum of many millions of dollars.

"That at this time, from the immensely increased appliances in use for said mining during several years last past, a great majority of said streams have been filled to their highest banks with said debris, and that all of the cereal-producing lands in the upper part of said valley, together with the beautiful cities and towns—and, in fact, the City of the Plains and State capital—are threatened with the same destruction ; and, unless the said threatened danger is speedily averted, the most inviting and productive valley on the continent will be uninhabitable for the aboriginal tribes.

"That for a number of years last past, the citizens of said portion of said valley have been building and constructing a succession of levee embankments, hoping to preserve to themselves and their families that portion of said valley not yet entirely and irrecoverably destroyed, with the results only of temporary safety, a depleted treasury, and final destruction in the near future.

"That the two great, heretofore navigable, rivers in said valley, to wit : the Sacramento and Feather Rivers, constituting as they do the only palladium of cheap fares and freights in said valley, together with the Bay of San Francisco, are being rapidly filled up and destroyed by the sand and gravel discharged from said mines.

"That the said citizens have been and now are taxed to the utmost tension of their capacity in repelling said threatened danger up to the present time, and are utterly helpless, without legislative aid, to much longer escape destruction.

"Wherefore, they pray that the foregoing should receive at your hands the attention its importance deserves ; and, believing that no one industry should be fostered to the utter annihilation of another, hope that your Honorable bodies will, in your wisdom, enact such laws on the subject as may be just to all, and benefit the greatest number."

On the Use of Pulverized Fuel.

Written for the ENGINEERING AND MINING JOURNAL.

By Chief Engineer B. F. ISHERWOOD, U. S. Navy.

EXPERIMENTS MADE AT SOUTH BOSTON, MASSACHUSETTS, TO DETERMINE THE ECONOMIC VALUE OF MESSRS. WHELPLEY & STORER'S PROCESS OF BURNING PULVERIZED COAL, MIXED WITH AIR AND FED BY A BLAST TO THE FURNACE ABOVE A BED OF INCANDESCENT LUMP COAL, COMPARATIVELY WITH BURNING LUMP COAL ALONE ON THE GRATES IN THE USUAL MANNER FOR THE GENERATION OF STEAM IN BOILERS.

CONTINUED FROM PAGE 33.

RELATIVE ECONOMIC VALUE AT EQUAL RATES OF COMBUSTION, OF EQUAL WEIGHTS OF THE COMBUSTIBLE PORTION OF ANTHRACITE AND SEMI-BITUMINOUS COAL.

To determine the relative economic value of the anthracite and the semi-bituminous coal, consumed in the lump state alone, with equal rates of combustion, experiment A is comparable with experiment F; and experiment B with experiment G.

In experiment A, burning anthracite at the rate of nearly 12 pounds per hour per square foot of grate-surface, the pound of its combustible vaporized 8.654 pounds of water from the temperature of 212 degrees Fahrenheit and under the atmospheric pressure; while in experiment F, in which there was very nearly the same rate of combustion of semi-bituminous coal, the pound of its combustible vaporized, under the same conditions, 9.857 pounds of water. Hence, the economic value of the pound of combustible matter in the semi-bituminous coal, was $\frac{9.857-8.654\times100}{8.654} = 13.90$ per centum greater than that of the pound of combustible matter in the anthracite.

Again, in experiment B, burning anthracite at the maximum rate of nearly 15 pounds per hour per square foot of grate-surface, the pound of its combustible vaporized 7.673 pounds of water from the temperature of 212 degrees Fahrenheit and under the atmospheric pressure; while in experiment G, in which there was very nearly the same rate of combustion of semi-bituminous coal, the pound of its combustible vaporized, under the same conditions, 9.530 pounds of water. Hence, the economic value of the pound of combustible in the semi-bituminous coal, was $\frac{9.530-7.673\times100}{7.673} = 24.20$ per centum greater than that of the pound of combustible in the anthracite. It will be observed that the economic value per pound of the combustible portion of the semi-bituminous coal over that of the anthracite was greater, relatively, with the higher rate of combustion than with the lower one.

To determine the relative economic value of the anthracite and the semi-bituminous coal, consumed in the pulverized state intimately mixed with air and above a bed of incandescent lump coal of the same kind, experiment D is comparable with experiments H and I; and experiment E with experiment J.

In experiment D, burning the pulverized and lump anthracite at the rate of nearly 12 pounds per hour per square foot of grate-surface, the pound of its combustible vaporized 7.498 pounds of water from the temperature of 212 degrees Fahrenheit and under the atmospheric pressure; while in experiments H and I, in which there was very nearly the same rate of combustion of semi-bituminous coal, the pound of its combustible vaporized (the mean of the two) $\frac{10.225+}{2} = 10.371$ pounds of water, under the same conditions. Hence, the economic value of the pound of combustible matter in the semi-bituminous coal was $\frac{10.371-7.498\times100}{7.498} = 38.31$ per centum greater than that of the pound of combustible matter in the anthracite.

Again, in experiment E, burning the pulverized and lump anthracite at the rate of nearly 16 pounds per hour per square foot of grate-surface, the pound of its combustible vaporized 7.206 pounds of water from the temperature of 212 degrees Fahrenheit and under the atmospheric pressure; while in experiment J, in which there was very nearly the same rate of combustion of semi-bituminous coal, the pound of its combustible vaporized, under the same conditions, 8.755 pounds of water.

Hence, the economic value of the pound of combustible in the semi-bituminous coal, was $\frac{8.755-7.206\times100}{7.206} = 21.50$ per centum greater than that of the pound of combustible in the anthracite.

It will be observed that the economic value per pound of the combustible portion of the semi-bituminous coal over that of the anthracite, was greater, relatively, with the lesser rate of combustion than with the higher one, which is exactly the reverse of the corresponding experiments with lump coal alone.

The mean of all the determinations shows that *the economic value of a pound of the combustible portion of the semi-bituminous coal is* $\frac{13.90+24.20+38.31+21.50}{4} =$ *24.48 per centum more than that of a pound of the combustible portion of the anthracite, at equal rates of combustion.*

This result is enormously greater than other experiments with anthracite and semi-bituminous coal made with other boilers, have shown, and is certainly due to some abnormal conditions operating strongly against the anthracite. It may be owing to the smallness of the grate-surface used, which made the lumps of anthracite relatively larger than when burned on larger grates, and allowed a larger portion of air to pass through unconsumed than in the case of the very small lumps and fragments of the semi-bituminous coal.

PROPORTION OF THE TOTAL WEIGHT CONSUMED OF ANTHRACITE AND OF SEMI-BITUMINOUS COAL, WHICH COULD BE CONSUMED IN THE PULVERIZED STATE.

An examination of experiments D and E, shows that, *of the total weight of anthracite consumed, 33 per centum could be consumed in the pulverized state intimately mixed with air and blown into the furnace above the bed of incandescent lump coal, on which was consumed the remaining 67 per centum.*

An examination of experiments H, I, and J, shows that, *of the total weight of semi-bituminous coal consumed, 60 per centum could be consumed in the pulverized state intimately mixed with air and blown into the furnace above the bed of incandescent lump coal, on which was consumed the remaining 40 per centum.*

Nearly twice as much of semi-bituminous coal could be consumed in the pulverized state as of the anthracite.

RELATIVE ECONOMIC VALUE OF ANTHRACITE CONSUMED WHOLLY IN THE LUMP STATE, OR PARTLY IN THE LUMP AND PARTLY IN THE PULVERIZED STATE.

The mean of experiments A and B, made with lump anthracite alone, and with rates of combustion respectively of nearly 12 and 15 pounds of anthracite per hour per square foot of grate-surface, shows that the pound of the combustible portion of the anthracite vaporized, under the atmospheric pressure and from the temperature of 212 degrees Fahrenheit, $\frac{8.654+7.673}{2} = 8.163$ pounds of water; while the mean of experiments D and E, made with 67 per centum of the anthracite consumed in the lump state and 33 per centum consumed in the pulverized state, and with rates of combustion respectively of nearly 12 and 16 pounds of anthracite per hour per square foot of grate-surface, shows that the pound of the combustible portion of the anthracite vaporized, under the atmospheric pressure and from the temperature of 212 degrees Fahrenheit, only $\frac{7.498+7.206}{2} = 7.352$ pounds of water. Hence, it appears that *in the case of anthracite, the use of 33 per centum of it in the pulverized state causes a loss of* $\frac{8.163-7.352\times100}{8.163} = 9.93$ *per centum of its economic value when used wholly in the lump state.*

RELATIVE ECONOMIC VALUE OF SEMI-BITUMINOUS COAL CONSUMED WHOLLY IN THE LUMP STATE, OR PARTLY IN THE LUMP AND PARTLY IN THE PULVERIZED STATE.

The mean of experiments F and G, made with lump semi-bituminous coal alone, and with rates of combustion respectively of nearly 12 and 15 pounds of coal per hour per square foot of grate-surface, shows that the pound of the combustible portion of the semi-bituminous coal vaporized, under the atmospheric pressure and from the temperature of 212 degrees Fahrenheit, $\frac{9.857+9.530}{2} = 9.693$ pounds of water; while the mean of experiments H and I $\frac{10.225+10.517}{2} = 10.371$ lb., and of experiment J, made with 40 per centum of the semi-bituminous coal consumed in the lump state and 60 per centum consumed in the pulverized state, and with rates of combustion respectively of nearly 12 and 16 pounds of semi-bituminous coal per hour per square foot of grate surface, shows that the pound of the combustible portion of the semi-bituminous coal vaporized under the atmospheric pressure and from the temperature of 212 degrees Fahrenheit, $\frac{10.371+8.755}{2} = 9.563$ pounds of water. Hence, it appears that *in the case of semi-bituminous coal, the use of 60 per centum of it in the pulverized state, causes a loss of* $\frac{9\ 693-9.563\times100}{9.693} = 1.34$ *per centum of its economic value when used wholly in the lump state.*

RELATIVE ECONOMIC VALUE OF ANTHRACITE, BOTH IN THE LUMP AND IN THE PULVERIZED STATE, WHEN BURNED AT THE MAXIMUM RATE OF COMBUSTION, AND WHEN BURNED AT THE RATE OF ABOUT 12 POUNDS PER HOUR PER SQUARE FOOT OF GRATE SURFACE.

As the anthracite in these experiments was consumed at different rates of combustion, the influence exerted upon its economic value by this difference of rate can be ascertained.

In experiment A, burning lump anthracite alone, 10.228 pounds of its combustible portion were consumed per hour per square foot of grate-surface, and vaporized per pound of combustible, 8.654 pounds of water, under the atmospheric pressure and from the temperature of 212 degrees Fahrenheit. In experiment B, burning lump anthracite alone, 13.284 pounds of its combustible portion were consumed per hour per square foot of grate-surface, and vaporized per pound of combustible, under the same conditions, 7.673 pounds of water. Hence, *in the case of using lump anthracite alone, an increase in the rate of the combustion of its combustible portion of* $\frac{13.284-10.228\times100}{10.228} = 29.88$ *per centum, decreased its economic value* $\frac{8.654-7.673\times100}{8.654} = 11.33$ *per centum.*

Again, in experiment D, burning 32.13 per centum of the anthracite in the pulverized state and 67.87 per centum in the lump state, 10.167 pounds of its combustible portion were consumed per hour per square foot of grate surface, and vaporized per pound of combustible, 7.498 pounds of water, under the atmospheric pressure and from the temperature of 212 degrees Fahrenheit. In experiment E, burning 33.00 per centum of the anthracite in the pulverized state, and 67.00 per centum in the lump state, 13.756 pounds of its combustible portion were consumed per hour per square foot of grate surface, and vaporized per pound of combustible, under the same conditions, 7.206 pounds of water. Hence, *in the case of using 33 per centum of the anthracite in the pulverized state and 67 per centum in the lump state, an increase in the rate of the combustion of its combustible portion of* $\frac{13.756-10.167\times100}{10.167} = 26.09$ *per centum, decreased its economic value* $\frac{7.498-7.206\times100}{7.498} = 3.89$ *per centum.*

RELATIVE ECONOMIC VALUE OF SEMI-BITUMINOUS COAL, BOTH IN THE LUMP AND IN THE PULVERIZED STATE.

The experiments furnish the necessary data for ascertaining, in the case of the semi-bituminous coal, the influence exerted on its economic value by burning it with different rates of combustion.

In experiment F, burning lump semi-bituminous coal alone, 10.286 pounds of its combustible portion were consumed per hour per square foot of grate surface, and vaporized per pound of combustible, 9.857 pounds of water, under the atmospheric pressure, and from the temperature of 212 degrees Fahrenheit. In experiment G, burning lump semi-bituminous coal alone 13.234 pounds of its combustible portion were consumed per hour per square foot of grate surface, and vaporized per pound of combustible, under the same conditions, 9.530 pounds of water. Hence, *in the case of using lump semi-bituminous coal alone, an increase in the rate of the combustion of its combustible portion of* $\frac{13.234-10.286\times100}{10.286} = 22.28$ *per centum, decreased its economic value* $\frac{9.857-9.530\times100}{9.857} = 3.32$ *per centum.*

Again, in experiments H and I, burning as a mean 60.24 per centum of the

semi-bituminous coal in the pulverized state, and 39.76 per centum in the lump state, there were consumed, as a mean, $\frac{10.921+11.066}{2} = 10.993$ pounds of its combustible portion per hour per square foot of grate surface, and vaporized per pound of combustible, as a mean, $\frac{10.225+10.517}{2} = 10.371$ pounds of water, under the atmospheric pressure, and from the temperature of 212 degrees Fahrenheit. In experiment J, burning 61.60 per centum of the semi-bituminous coal in the pulverized state and 38.40 per centum in the lump state, 14.855 pounds of its combustible portion were consumed per hour per square foot of grate surface, and vaporized per pound of combustible, under the same conditions, 8.755 pounds of water. Hence, *in the case of using 60 per centum of the semi-bituminous coal in the pulverized state and 40 per centum in the lump state, an increase in the rate of the combustion of its combustible portion of* $\frac{-10.993\times100}{10.993} = 26.00$ *per centum decreased its economic value* $\frac{10.371-8.755\times100}{10.371} = 15.58$ *per centum.*

Taking the mean of all the determinations for both the anthracite and the semi-bituminous coal, it appears that *increasing the rate of combustion from* $\frac{10.228+10.167+10.280+10.993}{4} = 10.418$ *pounds of combustible to* $\frac{13.284+13.756+13.234+14.855}{4} = 13.782$ *pounds per hour per square foot of grate-surface, or* $\frac{13.782-10.418\times100}{10.418} = 32.29$ *per centum, decreased its economic value from* $\frac{8.654+7.498+9.857+10.371}{4} = 9.095$ *pounds of water vaporized by one pound of combustible from the temperature of 212 degrees Fahrenheit, and under the atmospheric pressure, to* $\frac{7.673+7.206+9.530+8.755}{4} = 8.291$ *pounds or* $\frac{9.095-8.291\times100}{9.095} = 8.84$ *per centum.*

RELATIVE ECONOMIC VALUE OF LUMP ANTHRACITE BURNED WITH AS LITTLE AIR AS PRACTICABLE, AND BURNED WITH THE QUANTITY OF AIR WHICH GAVE THE HIGHEST EVAPORATIVE EFFECT.

Experiment C was made with lump anthracite alone, burned with as little air as practicable. The rate of combustion was 10.309 pounds of the combustible portion of the anthracite, per hour per square foot of grate-surface, and the vaporization per pound of combustible was 7.581 pounds of water from the temperature of 212 degrees Fahrenheit, and under the atmospheric pressure. This experiment is rigorously comparable with experiment A, in which lump anthracite was used alone, and with almost exactly the same rate of combustion as in experiment C, namely, 10.228 pounds of the combustible portion of the anthracite per hour per square foot of grate-surface, but in which the anthracite was burned with the admission of the quantity of air that experiment proved to give the greatest evaporative effect. Under the circumstances, the pound of combustible vaporized under the same conditions, 8.654 pounds of water; showing that *burning the anthracite with the least practicable quantity of air, instead of burning it with the quantity which gave the greatest evaporative effect, decreased the economic value of the pound of its combustible* $\frac{8.654-7.581\times100}{8.654} = 12.40$ *per centum.*

TO BE CONTINUED.

The Velocity of Blast-Furnace Gas.*

By JOHN A. CHURCH, E. M., Tarrytown, N. Y.

THE Lake Superior blast-furnaces probably represent the *maximum* economy of fuel possible in this country. They smelt an ore which is very rich and easily reducible, and as the small amount of gangue present is not all silica but, in part, a silicate, the amount of limestone required is a minimum. The average yield of the ore treated at six furnaces was 63 per cent., and the average quantity of limestone 179 pounds per ton of pig. The fuel used is charcoal, so burned as to retain most of the combustible volatile part, which, before the utilization of furnace-gas, was burnt away. With these conditions it is not surprising that the Lake Superior charcoal practice is extraordinary in almost every respect. In any scientific discussion of American furnace work, the establishments there, will be found at the head of the list, and they work under conditions which are extremely favorable for careful study.

The Bay Furnace, near Marquette, has the honor of carrying "the broom" for the largest daily make. With a capacity of 1,908 cubic feet it has, for months together, produced 29 tons of pig, graded at about No. 1.49, with 1,922 lb. of charcoal per ton. It makes a ton of pig daily for every 73 cubic feet of capacity, and burns only 13 cwt. of pure carbon to do it.

Of the four stacks which I visited, the Morgan Furnace, on the line of the Marquette and Ontonagon Railroad, stands next in order of production. It has a capacity of 1,679 cubic feet, and averages 20.46 tons per day, though its make for weeks together runs up to 27 tons, and it has made more than 30 tons for a short time. Its average gives a make of one ton to 82 cubic feet, with 1,911 lb. of charcoal. This is the greatest economy of fuel noticed, and corresponds to 12.8 cwt. of pure carbon.

The Deer Lake Company have two stacks, one of which is 45 feet high, like the two mentioned above, and has a capacity of 1,566 cubic feet. It makes 18 tons a day, on the average, or one ton to 87 cubic feet. Fuel is 2,457 lb. per ton of pig, corresponding to 16·45 cwt. of pure carbon. The other stack was formerly noticeable from its extreme smallness, compared with other modern furnaces. It was only 33 feet high, with boshes of eight feet, and possessed a hot blast oven which was one-half larger than that of any other furnace in the district. As its blowing cylinder was run by water power, it was able to keep its blast to a uniformly high temperature. This little furnace, with a capacity of 968 cubic feet, averaged 13·3 tons of pig per day, or one ton to 73 cubic feet, consuming 2,404 lb. of charcoal, or 16·1 cwt. of pure carbon per ton.

In addition to the above, I am enabled, by the kindness of the proprietors, to add two instances of charcoal and one of bituminous practice, though I did not visit the furnaces. To this list of examples are added three of anthracite practice.

* A paper read at the Cleveland Meeting of the American Institute of Mining Engineers, October. 29, 1875

The Lake Superior furnaces probably offer the simplest blast furnace problems to be found in this country. I was not in a position to make the gas analyses necessary for accurately gauging their performance, but it struck me that with an economy so near the maximum, the possible error in making approximate calculations would be very small, and I accordingly calculated the heat requirement and heat expenditure, and the amount of carbon burned in the hearth. The object of the calculations was to arrive at the velocity of the gas in the furnace. It is usual to look upon this velocity as enormous, but having made some calculations under less favorable conditions, I had been surprised to find the rate of ascent comparatively small. It is evident that there are two different velocities in the furnace, the velocity of the nitrogen and carbonic oxide in the lower part, and that of the gas in the upper part; this gas being composed of nitrogen, carbonic oxide, oxygen of the ore and volatile constituents of the fuel. Each part has its own average temperature, with a corresponding expansion of the gas. The section of a furnace changes so rapidly in area that it is evidently impossible to take this element into consideration. The only method possible is to find the average velocity for a given height, and this has been done by ascertaining the interstitial space lying between the masses of "mine" and fuel, and then comparing this with the quantity of gas rising through the furnace per minute. By this method the number of times the gas fills this interstitial space per minute is found, and multiplying this by the height of the column, we have the total vertical ascent or velocity.

To obtain the interstitial space, the weight of a cubic foot of stock was determined by carefully measuring the ore and coal-barrows. By comparing these weights with the quantities used in filling the furnace the deduction necessary for the greater compactness of the stock in the furnace, than in the barrows, was found. This was determined at 10 per cent. for charcoal, and 15 to 20 per cent. for bituminous and anthracite furnaces. By calculating the true solid contents of the materials from their specific gravities, we have two elements—the bulk of the materials as charged and their real solid contents—the difference between which is the interstitial or vacant space.

Of course, these results are only approximate, and can be improved only by making a great number of determinations. But after checking the results in all possible ways, the error will probably not be very great. This is especially true for small charcoal furnaces.

A more difficult problem was to determine the height of the two zones for which the calculations were made. The limits of the lower zone are at bottom the tuyere level, at top that point in the furnace at which the evolution of carbonic acid from the limestone, oxygen from the ore, and volatile from the fuel ceases. With gas of a constant composition and velocity this point depends upon the temperature selected. For these calculations the temperature has been taken at 700° C., or about 1,300° F., at which it is probable most of the vaporizable constituents will be driven off, in a constant current of reducing gas. In the charcoal furnaces, which are of nearly equal height and have an effective column of about 39 feet between the tuyeres and the upper level of the stock, this line of 700° C. was assumed to lie at one-third the distance, or 13 feet, from the top of the column. In the bituminous and one anthracite furnace treat mainly Lake Superior ores, both of about the same height of column, the 700° C. line was placed at the same point. In the two large anthracite furnaces, with a larger area and a slower velocity, the line was placed at 12 feet from the top, and probably it is too low in both.

The temperature in the crucible was assumed at 1500° C., and the mean temperature in the lower zone is therefore $\frac{1500+700}{2} = 1100°$ C. This may be thought too low, for the determinations of the fusing point of pig iron have varied between 1050° C. and 1700° C., while those of wrought iron vary between 1600° C. and 2100° C. But as the tendency of late investigations is to assign 2032° C as the limit to the sun's temperature, I am justified in assuming the correctness of the lower determinations. The temperature of the blast furnace is not sufficient to fuse wrought iron, while the sun is hot enough to keep that metal in a state of vapor.

The average temperature of the upper region is equal to (700° C., *plus* the temperature of the exit gas) divided by 2; it has varied between 450° C. and 550° C.

From these data it was found that in six Lake Superior charcoal furnaces, the

Velocity of the gas in the lower part averaged 14.7 ft. per second.
Velocity " " " upper " " 16.4 " "

In the bituminous furnace, smelting Lake Superior ores, the

Velocity of gas in the lower part averaged 17.3 ft. per second.
Velocity " " upper " " 19.5 " "

In an anthracite furnace of about the same height, but larger section, than the charcoal furnaces, but also treating Lake Superior ores, the

Velocity of gas in the lower part averaged 11 ft. per second.
Velocity " " upper " " 10.3 " "

In two large anthracite furnaces, treating Lake Champlain ores, the

Velocity of gas in the lower part was { 13.3 ft. per second. / 6.9 " "
Velocity " " upper " " { 10.8 " " / 4.6 " "

The solid materials descended at the rate of

In the charcoal furnaces, Lake Superior ores, 3.87 ft. per hour.
" " bituminous " " " " 2.4 " "
" " anthracite " " " " 0.73 " "
" " " " Lake Champlain ores, 0.90 " "
" " " " " " 0.55 " "

Thus it is evident that the velocity of gas is not so great as many furnace men suppose. Fifteen feet per second, as in the charcoal furnaces, is two-and-a-half times the periphery velocity of a good water-wheel. It is 10¼ miles an hour, or less than twice as fast as hoist cages move in mines, or cars on the long "planes" found in coal regions. In fact it is not an excessive velocity for mechanical movements.

The study which has led to the preparation of this paper was undertaken to disprove an argument which has been urged against the theory that reduction of the ore takes place by the action of carbonic oxide. The objection was that the gas moved too rapidly to allow of any complete action. Of course this is absurd on its face, since the ore is continually bathed in the reducing agent, but these calculations show that the fact of the supposed excessive velocity does not exist.

From an inspection of the velocities found, it is apparent that a position might have been chosen for the 700° C. line (or a proper temperature for the two-thirds division) which would have given equal gas velocities in the two zones. In the Morgan furnace this line probably does lie just 12½ feet below the top, as the table shows; for the velocities above and below are 13.7 and 14 feet per second. In the Bay furnace the line is placed at 13 feet, but is no